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PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotia Institute of Natural Science,

OF

HALIFAX, NOVA SCOTIA.

VOL. VI. 1882-83. PART I.

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HALIFAX, NOVA SCOTIA—WILLIAM GOSSIP, 103 GRANVILLE ST.

1883.

Price One Dollar.

PROCEEDINGS
OF THE
Nova Scotian Institute of Natural Science.

VOL. VI. PART I.

Provincial Museum, Oct. 11, 1882.

ANNIVERSARY MEETING.

JOHN SOMERS, M.D., F.R.M.S., *President, in the Chair.*

INTER ALIA.

The following gentlemen were elected office-bearers for the ensuing year —

President—JOHN SOMERS, M.D., F.R.M.S.

Vice-Presidents—ROBERT MORROW, Esq., MARTIN MURPHY, C. E.

Treasurer—W. C. SILVER, Esq.

Secretaries—Prof. D. HONEYMAN, D.C.L., ALEXANDER MCKAY, Esq.

Council—J. B. GILPIN, M.D., WM. GOSSIP, AUGUSTUS ALLISON, J. M. JONES, SIMON D. MCDONALD, JAS. R. DEWOLFE, M. D., EDWIN GILPIN, WM. M. HARRINGTON.

ORDINARY MEETING, November 13, 1882.

The PRESIDENT *in the Chair.*

The PRESIDENT delivered an address in which the status and valuable work done by the Institute were pointed out, and encouragement given to new workers in various fields yet open to scientific research.

Prof. HONEYMAN, D.C.L., read a paper "On the Micro-Polariscopic Investigation of the Crystalline Rocks of the Gold-bearing Series of Yarmouth." After some remarks by Prof. LAWSON, the meeting adjourned.

ORDINARY MEETING, December 11, 1882.

The PRESIDENT *in the Chair.*

Prof. LAWSON, Ph. D., LL. D., read a paper, entitled, "Notice of some New or Rare Plants."

Prof. D. HONEYMAN, D. C. L., read a paper on "Chebucto Nullipores, with *attaches.*"

The PRESIDENT announced that JOHN Y. GUNN, Government Inspector of Schools for Inverness and Cape Breton, had been elected Associate member by the Council.

Special Meeting, January 2, 1883.

Robert Morrow, Esq., *Vice-President, in the Chair.*

Inter Alia.

A letter was read from the Royal Society of Canada, inviting the Nova Scotian Institute of Natural Science to send a delegate to the next meeting of the Royal Society.

On motion of Messrs. Gilpin and Jack, it was

Resolved, That the Institute cordially receive the communication of the Royal Society of Canada, and that they agree to carry out the request of the Society by electing a delegate.

Ordinary Meeting, January 8, 1883.

Robert Morrow, Esq., *Vice-President, in the Chair.*

Dr. Somers, the *President,* read a paper "On the Anatomy of the Heart of a Moose."

Prof. Honeyman, D.C.L., read a paper "On Nullipores."

Special Meeting, 31st Jan., 1883.

John Somers, M. D., *President, in the Chair.*

Inter Alia.

The Committee appointed to prepare a letter in reply to the letter of the Royal Society of Canada, reported as follows: "At the last meeting of the Nova Scotian Institute of Natural Science, it was resolved that the Institute reciprocate the friendly greeting of the Royal Society of Canada, and agree to elect a delegate to the Society in accordance with the request embodied in their letter of the 17th Nov., 1882."

William Gossip, Esq., was elected.

Ordinary Meeting, 12th Feb.

John Somers, M. D., *President, in the Chair.*

Inter Alia.

Prof. Honeyman, D. C. L., read a paper "On Glacial Transportation in Nova Scotia and Beyond,—Problem of 1873 solved."

The President read a paper "On the Winter Food of the Partridge (Bonosa umbellus), and on Partridge Poisoning."

It was intimated that Dr. McKenzie had been elected an Associate Member and Capt. England an Ordinary Member.

ORDINARY MEETING, 17th March.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

INTER ALIA.

A letter was read from the Royal Society of Canada announcing the second session to be held at Ottawa, on the 21st day of May next, and requesting the titles and abstracts of papers to be sent in before the 15th.

SIMON D. MACDONALD, F. G. S., read a paper "On Sable Island."

Prof. LAWSON, Ph.D., LL. D., read a paper "On New and Rare Plants of Nova Scotia and Ferns of Bermuda."

SPECIAL MEETING, 22nd March.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

ORDINARY MEETING, 9th April.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

INTER ALIA.

EDWIN GILPIN, Esq., A. M., read a paper "On the Analysis of a Pictou Coal Seam."

Prof. MACGREGOR read a paper "On the Resistance to the Passage of the Electric Current between amalgamated Zinc Electrodes and weak solutions of Zinc Sulphate."

ORDINARY MEETING, 14th May.

JOHN SOMERS, M. D., *President, in the Chair.*

Prof. HONEYMAN, D.C.L., being absent, his paper "On the Geology of Nova Scotia,—Halifax and Colchester Counties. Part 1," was read by the Secretary.

The PRESIDENT read a paper "On some additions to the Flora of Nova Scotia."

A. McKAY, *Secretary.*

LIST OF MEMBERS.

Date of Admission:			
1873.	Jan.	11.	Akins, T. B., D.C.L.. Halifax.
69.	Feb.	11.	Allison, Augustus, Meteorologist, Halifax.
77.	Dec.	19.	Bayne, Herbert E., Ph. D., Prof. Chemistry, Royal Military College, Kingston.
64.	Nov.	7.	Brown, C. E., Halifax.
67.	Sept.	10.	Cogswell, A. C., D.D.S., Halifax.
72.	April	12.	Costley, John "
63.	Oct.	26.	DeWolfe, James R., M.D., L.R.C.S.E.
82.	May	8.	Fox, John J., Halifax.
78.	Jan.	30.	Geldert, J. M., Barrister, Halifax.
73.	April	11.	Gilpin, Edwin, F. G. S., M. R. S. C., Government Inspector o Mines, Halifax.
63.	Jan.	5.	Gilpin, J. Bernard, M. D., M.R.C.S.L., M.R.S.C., Annapolis.
63.	Feb.	5.	Gossip, Wm. *Vice-President*, Halifax.
63.	Feb.	5.	Downs, Andrew, M.Z.S., Taxidermist, Halifax.
83.	Mar.	12.	England, Captain.
			Forbes, John, Starr Manufacturing Co., Dartmouth.
			Foster, James G., Barrister, Dartmouth.
81.	Dec.	12.	Hare, Alfred, Bedford.
82.	April	10.	Harrington, Wm., Halifax.
82.	April	10.	Harrington, D., M.D., Halifax.
63.	June	17.	Hill, Hon. P. C., D.C.L., Halifax.
66.	Dec.	3.	Honeyman, Prof. D., D. C. L., *Secretary*, Curator of the Provincial Museum, Halifax.
74.	Dec.	10.	Jack, Peter, Cashier of People's Bank, Halifax.
63.	Jan.	5.	Jones, J. M., F.L.S., M.R.S.C., Berwick.
82.	April	10.	Keating, G. H., C. E., City Engineer, Halifax.
64.	March	7.	Lawson, G., Ph. D., LL. D., F.C.I., Professor of Chemistry and Mineralogy, Halifax.
81.	Mar.	14.	Macdonald, Simon D., F.G.S., Halifax.
77.	Jan.	13.	MacGregor, J. G., D.Sc., F. R. S. E., M.R.S.C., Prof. of Physics, Dalhousie College, Halifax.
72.	Feb.	5.	McKay, Alexander, *Secretary*, Supervisor of Halifax Public Schools.
78.	Nov.	11.	McLeod, John R., Demerara, West Indies.
78.	Jan.	11.	Mellish, John T., A.M., Halifax.
77.	Jan.	13.	Morrow, Geoffrey, "
72.	Feb.	13.	Morrow, Robt., Halifax.

Date of Admission:

70.	Jan.	10.	Murphy, Martin, C.E., Provincial Engineer, Halifax.
79.	Dec.	29.	Neal, W. H., Halifax.
65	Aug.	29.	Nova Scotia, the Right Rev. Hibbert Binney, Lord Bishop of Halifax.
82.	April	10.	Plunkett, C. W., C.E., Halifax.
79.	Nov.	11.	Poole, H. S., Assoc. R.S.M., F.G.S., Superintendent of Acadia Mines, Pictou.
76.	Jan.	20.	Power, Hon. L. G., Senator, Halifax.
71.	Nov.	19.	Reid, A. P., M D., Sup't of Prov. Lunatic Asylum, Dartmouth.
65.	Jan.	8.	Rutherford, Jas., M.E., Sup't of Albion Mines, Pictou.
64.	May	7.	Silver, W. C., *Treasurer*, Halifax.
75.	Jan.	11.	Somers, John, M. D., F. R. M. S., Prof. of Physiology and Zoology, Halifax Medical College.
81.	Dec.	11.	Burbidge, D. H., Halifax.

ASSOCIATE MEMBERS.

77.	May	14.	Burwash, Rev. John, A.M., Charlottetown, P.E.I.
82.	June	9.	Douglas, John
81.	Dec.	12.	Gisborne, F. H., Ottawa.
81.	Nov.	13.	Harris, C., Prof. of Civil Engineering, Royal Military College, Kingston.
75.	Nov.	9.	Kennedy, Prof. King's College, Windsor.
71.	Jan.	11.	McKay, A. H., B.A., B.Sc., Principal of Pictou Academy.
82.	Mar.	31.	McKenzie, W. B., Moncton, N. B.
83.	Mar.	12.	McKenzie, O. H., Inspector of Schools, Parrsboro'.
61.	Dec.	8.	Morton, Rev. John, Missionary of the Presbyterian Church of Canada, Trinidad.
78.	Mar.	12.	Patterson, Rev. George, D.D., New Glasgow.
81.	Mar.	14.	Stearns, T. G., Middleton, Annapolis Co.
80.	May	10.	Walker, James, M.D., St. John, N.B.
82.	Oct.	1.	Gunn, John Y., School Inspector, C. B.

CORRESPONDING MEMBERS.

71.	Nov.	29.	Ball, Rev. E. Tangier.
71.	Oct.	12.	Marcou, Jules, Cambridge, Mass. U.S.
80.	June	10.	McClintock, Sir Leopold, Knt., F.R.S., &c., Vice-Admiral.
77.	May	14.	Weston, Thomas C., Geological Survey of Canada.

LIFE MEMBER.

Parker, Hon. Dr., M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—NOTES ON A POLARISCOPIC EXAMINATION OF CRYSTALLINE ROCKS OF THE YARMOUTH GOLD-BEARING SERIES.—By PROF. HONEYMAN, D.C.L., &c. *Curator of the Provincial Museum.*

(Read Nov. 13, 1882.)

THE problematical character of those rocks, and their unexpected appearance in the gold bearing series—no similar rocks appearing elsewhere in the band, as far as observed,—led me to have sections prepared by A. A. JULIEN, New York, for microscopic and polariscopic examination.

1, 2. The rock at *Jebogue Point* has suggested a number of queries. (*Vide* Paper on " Geology of Digby and Yarmouth Counties." *Trans.* 1880.) Its appearance and relations suggested a comparison with the Igneous rocks of the Blomidon series. I had also a section made of Blomidon Basalt. The two examined by the polariscope are so much alike as to be regarded identical. The dark material of both is evidently Augite, and the clear crystals a triclinic feldspar. The latter polarized shew three parallel lines. Between two parallels the colour is a beautiful blue-white, the colour between the other two is dusky. Turning the polarizer the colours change place,—the dusky becoming blue, and the blue dusky. This seems to furnish a reply to my queries, and to refer the eruption at Jebogue Point to the *Paulo-post Triassic Period.*

3. Sunday Point Porphyrite.—A macroscopic examination

of this rock shows the existence of Biotite, Hornblende and crystals of a white feldspar. The polariscope shows the feldspar to be trichroic. The colours run in parallels, and the crystals shew beautiful striation.

4. Cranberry Point Diorite.—Macroscopically examined this rock shows abundance of Biotite and Hornblende. The Polariscope shews triclinic feldspar. This and the Porphyrite of Sandy Point seem to be closely related, but different from the Jebogue Point Dolerite. These two seem to be intrusive, but of a Lower Silurian age.

In considering the subject of the age of the gold-bearing rocks, it is evident that these crystalline rocks must be eliminated.

5. Yarmouth Harbour Rock.—This singular rock furnishes a very interesting section. It is composed of a glassy, undetermined mineral and hornblende. I have not been able to ascertain the nature of the former by the polariscope; portions of it seem to be a glass. One of the green hornblendic patches has a singularly pretty inclusion. In a small glassy area, bounded by two straight sides and two curved, is a perfectly round glassy inclusion. Turning the polarizer the inclusion darkens, until space and inclusion become altogether black.

Sections of other crystalline rocks are under examination. They will be the subjects of future notes.

ART. II.—CHEBUCTO NULLIPORES, WITH ATTACHES.—By PROF. D. HONEYMAN, D. C. L., &c. *Curator of the Provincial Museum.*

(Read December 11, 1882.)

OUR specimens appear to differ in their mode of growth. There is seemingly a vertical and a horizontal growth. Specimen No. 1 exhibits both. The upward growth developes into branches, the horizontal increases the body by layers, forming a *limestone*, having a concretionary and amorphous aspect.

Specimens Nos. 2 and 3 are amorphous. Of No. 1 the corallines encrust a stone. No. 2 and 3 are detached from their original support. Some of the tufts of the cespitose coralline have pits which have some resemblance to pores. Parts of the surface of the lamellar coralline have also numerous markings like pores. Still they are evidently nullipores.

Attaches 1 are specimens of *Algæ*, Rhodosperms. Cor. No. 2 has a large bunch of a beautiful *alga.*

This seems to be an article of food for fishes. I was familiar with it from the contents of fish stomachs before I met with it in its place of growth and was puzzled to ascertain its character.

Its name is *Ptilota Serrata.*

At. 2. In the recesses of the coralline tufts of specimen No. 1, are numerous foramenifera. In the bushy edge of specimen No. 2, are also specimens of the same foramenifer.

At. 3. On specimen 1 was a small *ophiura* star fish—Brittle Star.

At. 4. On specimen 1 are specimens of a species of Flustra.

At. 5. In specimen 2 are several *saxicava.* These have excavated their dwellings in the thick coralline,—No. 2 having entered betwen the base and the attachment.

At. 6. On all three are specimens of the pretty little gasteropod *chiton ruber.* There were many of these, more than can be now seen ; unfortunately the Museum mice examined the specimens, and appropriated several of the *chitons* and the little *ophiura.*

At. 7. Are two pretty little patellæ. One is whole, the other is crushed. The species is *Patelloida,* or *Lottia testudinalis.*

At. 8. Is another little patelloida. It is evidently a different species from *patelloida testudinalis.* It may be *patelloida alveus.*

There are also many little white subconical forms on the tufts of No. 1. I have not been able to ascertain their nature.

We have thus noticed: *Algae, Foramenifera, Ophiura, Polyzoa, Lamellibranchiata, Gasteropoda, Incertae sedis—7.*

There is another interesting nullipore to which I would direct attention. This, also, was dredged at the mouth of Halifax harbour. It is decidedly lamellar. Broken in two it shows a concretionary structure. On its surface is a considerable growth of the algæ *Ptilota serrata*. Branches of this lying on the coralline become imbedded by the calcareous growth. Some of these having been removed, have left indented impressions in the same way as ferns, &c., leave their impressions in Carboniferous shales. Other attaches are numerous foramenifera; many of these are lying in the *algæ*. Others on the coralline are sometimes partially imbedded and covered by the growth of the former. It is possible that parts of the *alga* and others of the foramenifera are enveloped in the coralline in the manner of fossils. No part of this coralline, although of considerable size, is cespitose. This seems to show that the cespitose corallines are distinct from the lamellar.

The under part is very striking. It is altogether separate from its original attachment, and seems to have been so for a considerable length of time. Several *saxicava* are imbedded, but all are dead. The valves of some have numerous small perforations. The operators, doubtless, succeeded in destroying the tenants.

Tub~~er~~iculous annelids (worms) in great numbers adhere to the base and its cavities. The inmates have long gone.

The tubes are of serpulæ, of, apparently, two species. One species has a singular head, or ending, while the other is plain. The ending has the form of a head, the opening having the appearance of a circular mouth. This form is evidently not accidental, as several have it.

Other tubes are spiral. *Spirorbis* of apparently three species. Some of these are attached to *saxicava*.

Some of the hollows are lined with *sponges*. Among the tubes are numerous foramenifera. Other attaches are two or three pretty little *anomia*.

SUMMARY.

Algæ, coralline, foramenifera, sponges, serpulæ, spirorbis saxicava, anomia.

GEOLOGICAL.

One specimen seems to throw some light on the mode of formation of one of our Carboniferous Limestones. In the Pictou carboniferous formation there is a considerable variety of limestones. Of the manner in which most of these were formed, and their age, there can be little doubt. The internal and collateral evidence is sufficient to determine these points. One of these limestones, however, is exceptional. Its mode of formation is obscure,—internal evidence of origin is wanting, and the age is subject to question. This limestone is imbedded in the sandstones, or high ground, north of New Glasgow. My attention was first directed to it in 1862. Polished specimens were among the economic minerals of our department at the London Exhibition. It was considered to be a limestone, or marble, that might be adopted for ornamental purposes. It is brown in colour, and has a concentric structure. I took an early opportunity of examining the deposit, and of securing characteristic specimens. One of these, which is in the Museum, was polished by Mr. Wesley, marble worker, for the Paris Exposition of 1867. It was found that the bed was of limited extent, and that the sandstone with which it was united interfered with the polishing. Another of the specimens, cut vertically, shows a sandstone base. On this there is first a calcareo-siliceous layer, which is amorphous. On this another is formed with several centres, above this it is beautifully concentric. The top of the specimen is cauliflower shaped. When Sir W. E. Logan and Mr. Hartley surveyed the Pictou coal fields in 1869, the latter examined the limestone, but was equally unsuccessful with myself in finding fossils which could determine the age of the formation. He succeeded, however, in finding one form, a *spirorbis*. There was a large number of these attached to a specimen somewhat resembling our own. The appearance was so striking and singular that I will not readily forget it. I presume that the specimen is now in the collection of the Geological Museum, Ottawa.

There is, therefore, reason to suppose that the Hartley specimens and our nullipore are analogous, as both have concretionary lamellar structure and attached spirorbes, and that the carboniferous concretionary limestone is coralline or nullipore in origin.

ART. III.—NOTES ON SABLE ISLAND. By SIMON D. MACDONALD, F. G. S.

(Read March 12, 1883.)

IN bringing this Island and its surroundings to your notice this evening, I feel I am opening up a rich field for the future investigation of this Institute.

From its geographical position—midway between this coast and the gulf stream—it possesses characteristics peculiar to itself, and a phenomena so varied that there is work here for us all.

But not only does this Island invite our attention in the interests of science, but *demands* our attention in the interests of *humanity*.

Situated directly in the pathway of commerce,—enshrouded for weeks together by impenetrable fog—encircled by eddies and currents of the most erratic character—its dangerous and ever-shifting sand-bars, together with its terrible record of disasters, dating back from the earliest history of this country—it has earned for itself among mariners the well-merited appellation, that of "the grave-yard of North America."

And were we to-morrow to visit this island and witness its wreck-strewn shores—the ghastly grin of skeletons protruding from the embankment or lying awash on the beach—and listen to the sickening tales of the surf-men, we would feel guilty, indeed, if we, as members of one of the oldest scientific societies in this Dominion, did not put forth our greatest effort to learn something of the causes whose effects are so fraught with destruction, and give to the world the benefit of our researches.

While compiling the wreck-chart of Sable Island which we have before us, I have had to examine the early records of the Province, from which I have gleaned many facts in connection with the history of this Island. Having had the opportunity of visiting it on two occasions, and learning something of it as it is to-day, I thought it well to place the results before you, to form, as it were, a basis for further investigations.

The first notice of this Island in history, is from the voyage of John Cabot, who, in company with his son, Sebastian, sailed from Bristol in 1547, in a vessel called the "Matthew." After making the land at Labrador, he sailed south and westward, coasting Newfoundland and Nova Scotia, as far as Cape Sable. Finding here the coast trending suddenly to the *north,* and being short of *provisions,* with an *unknown* sea before him, he wisely turned his prow homeward. On the third day he passed two islands to starboard, which, from their *position,* must have been some of the higher hummocks of Sable Island. Viewed at a *distance,* these might easily be taken for separate islands.

Three years later an expedition, ordered by Emanuel, King of Portugal, followed in the wake of Cabot; but meeting with reverses, they returned, disheartened, to Lisbon.

Private enterprizes, however, stimulated by the glowing accounts given by Cabot of seas *blocked* with fish, were continued from year to year, and hundreds of Portuguese fishermen resorted to the banks.

To these people the credit is given of having placed cattle and swine on the Island for the benefit of those who might be cast upon its shores. That they were well acquainted with the place, there can be little doubt.

On a chart made by Pedro Reinel, as early as 1505, of Newfoundland and this coast, as far as *Maine,* this island is laid down as "*Sanda Crus.*"

In the museum of Paris is another chart, made by Gaftaldi (of New France), in 1550, showing the fishing banks extending from off Lahave to Newfoundland, on which this island appears as "Isolla del Arena."

In 1518, Baron de Lery made the first attempt to colonize this New France, but meeting with a succession of gales, which drove him back several times, he arrived on this coast too late to place his people under shelter before winter would overtake them, so he left part of his cattle at Canso, and sailed for Sable Island, where he placed the remainder, and returned to France. In after years these cattle had so multiplied that it became a matter of speculation for parties to land and hunt them for their hides and tallow.

The next mention made of this island is in the record of the disastrous voyage of Sir Humphrey Gilbert, who sailed from England with a fleet of five armed vessels. Arriving at St. John's, Nfld.—he found a large fleet of fishermen, of different nations—and took formal possession of the place in the name of Queen Elizabeth. The Portuguese treated him well, and after supplying him with wines, marmalade, sweet oil, &c., told him of their having placed swine and cattle on Sable Island. Thither Sir Humphrey sailed.

Several days after, during a thick fog, he lost his second in command on Sable Island. As this is the first wreck of which there is any history, written in quaint old English, I will read it as recorded:

"Sabla lieth, to the seaward of Cape Breton about 45°, whither we were determined to go, upon intelligence we had of a Portingall, during our abode in St. John's, who was also himself present when the Portingalls, about 30 years past, did put into the same Island both neat and swine to breed, which were since exceedingly multiplied.

"The distance between Cape Race and Cape Breton is 100 leagues, in which navigation we spent 8 days. Having the wind many times indifferent good, but could never obtain sight of any land, all that time, seeing we were hindered by the current. At last we fell into such flats and dangers, that hardly any of us escaped. Where nevertheless we lost our Admiral, with all the men and provisions.

"Contrary to the mind of the expert Master Cox, on Wednesday, 27th August, we bore up toward the land. Those in the doomed ship continually sounding trumpet and drums. Whilst strange voices from the deep scared the helmsman from his post on board the Frigate.

"Thursday, the 28th, the wind arose and blew vehemently from the south and east,—bringing withal rain and thick mist, that we could not see a cable length before us. And betimes we were run and foulded amongst flats and sands, amongt which we found flats and deeps every 3 or 4 ship's lengths. *Immediately* tokens were given to the admiral to cast about to seaward, *which* being the *greater* ship, and of burden 120 tons, was performost upon the beach. Keeping so ill a watch they knew not the danger before they felt the same too late to recover, for presently the Admiral struck aground, and had soon her stern and hinder parts beaten in pieces. The remaining two ships escapad by casting about E.S.E., bearing to the south for their lives, even in the wind's eye. Sounding on while 7 fathom, then 5, then again deeper. The sea going mightily and high."

In the wreck of the "Delight," or "Admiral," as she was called, upwards of 95 *perished*, 12 only *escaped*, and afterwards reached the Nova Scotia coast and were carried by some French vessel to England.

In 1598, the Marquis "De la Roche" obtained a charter from Henry III. to colonize and Christianize New France, and sailed in May of that year. Arriving off this coast, and fearing that his people,—consisting of 40 convicts from the French prisons—might escape, he landed them on Sable Island until he could make arrangements to settle on the main land. On returning he encountered a furious gale which, in 15 days, drove him on the French coast. He had scarcely *landed*, when he was thrown into prison by an enemy, and was prevented from communicating the result of his voyage to the king. Five years after, the king, receiving *intelligence*, ordered the pilot who had led them thither to proceed to Sable Island and learn their fate, which was found to be deplorable. Out of the forty landed five years previous, only twelve remained alive.

Finding themselves alone, and deserted, as they thought, by the very one whom they looked to for liberty and comfort, they became desperate. With no law to *restrain*, nor punishment to *fear*, each man's hand was turned against his fellow, and several had come to a violent end. The remainder, from ill-prepared food and exposure, became reduced in spirits, and had *lately* led more quiet lives. After being landed on the Island they managed to erect huts from the remains of a Spanish vessel wrecked in the breakers, and maintained existence by eating the raw flesh of the cattle Baron de Lery, or the Portuguese, had placed on the Island many years before, and which had become very numerous. In a short time their clothes were worn out, and they dressed themselves in the skins of seals.

On their arrival in France they were presented to the king. Their savage expression, unkempt hair and beards, which reached to their waists, together with their pitiful tale of want and *exposure*, so moved the *king* that he gave them fifty crowns a piece and permission to return to their homes. Strange to say, they afterwards sought passage to the island, where they accumulated a large quantity of fur.

In 1633, John Rose, of Boston, lost his vessel—the "Mary & Jane"—at this place. He was here three months constructing a yawl from the remains of his vessel, by which he reached the main land. His reports of having seen "more than 800 head of wild cattle, and a great many foxes, many of which were *black*," so interested the Acadians that 17 of them embarked in a vessel, taking Rose as pilot. After this Rose returned to New England, where the tidings of this wonderful Island soon spread. A company was soon formed at Boston to hunt on the Island. On their arrival they found that the 17 Frenchman who had wintered on the Island, had built houses and a fort, and so slaughtered the cattle that only 150 remained.

About 100 years *later*, a French clergyman named LeMercier, claiming to be an Englishman by naturalization, sent thither a number of cattle, previous to removing with his family. He had petitioned Governor Armstrong, at Annapolis, for a grant of the Island, but declining to pay a Quit rent to the government, the grant was withheld. A proclamation was issued forbidding persons from killing those animals, and they continued there for many years. At what period they were destroyed, and succeeded by the wild horses now upon it, is not known.

From this date up to the beginning of the present century, we have little information respecting this Island, except that it became a favourite resort of fishermen, for the purpose of hunting the walrus and seal.

With the increase of commerce, wrecks were more frequent, and it became the haunt of pirates and wreckers of the worst description, who are said to have lighted fires on the shore luring vessels to their destruction. Valuable jewels and rare articles having been exhibited as coming from there from time to time, strange stories of piracy and *murder* became frequent.

This, together with the report of several vessels being lost with all hands, in quick succession—among them being the "Princess Amelia," a transport having on board the household effects of the Duke of Kent and upwards of 200 officers and recruits, all of whom perished, although it was thought that many of them reached shore and were afterwards murdered by the pirates, excited the suspicions of the authorities.

The gun brig "Harriet" was dispatched, under Lieut. TORRENS, to investigate matters, when she, *too*, was lost. The government at once took action, and, by the advice of Sir JOHN WENTWORTH, an amount was appropriated for settling families on the Island to assist shipwrecked persons and for saving property.

A proclamation was issued, stating that persons found residing upon the Island without a license from the government would be removed and imprisoned for a period of not less than six years. This had the desired effect, driving off the wretches who infested it, and the present establishment was formed under the superintendence of one JAMES MORRIS in 1802.

Such is the early history which, though dim and fragmentary, yet serves to show that the Island was well known and frequented hundreds of years before the founding of Halifax; and that by a race of people who have left no descendants along our coast.

We will now consider the general features of this Island. It is simply an enormous accumulation of loose grey sand, forming two parallel ridges united at either extremity. It is crescent-shaped, with its inner side towards the coast.

The valley formed by these parallel ridges extends the length of the Island, 8 miles of which is occupied by a lake. A narrow ridge separates this lake from the ocean on the south, over which the sea breaks in many places during heavy weather.

According to the last admiralty survey, this Island is situated 85 miles from White Head, the nearest point on the Nova Scotia coast. The west end is in lat. 43, 56, N., and 60, 08, W. long.,—22 miles in length and 1 mile in breadth.

From a northern approach it presents the appearance of a succession of low, naked sand hummocks, some partially covered with vegetation. Beginning at the west end, those hills or hummocks have an elevation of about 20 feet, gradually rising eastward, attaining the height of about 80 feet in the vicinity of the east end light, beyond which they slope away until they meet the N. E. bar, which in fine weather dries for a distance of 4 miles from the grassy sand hills. About two miles from the beginning of this bar, an island is forming over an old wreck, and is covered with grass.

This dry bar is succeeded by 9 miles of heavy breakers, to a depth of 6 fathoms, 4 miles further with a heavy cross sea, with from 10 to 13 fathoms, and then ends abruptly, the depth increasing in a distance of 3 miles to 170 fathoms.

The N. W. bar dries about 1½ miles from the grass hills, with patches or shoals *nearly dry* one mile further out. Then 9 miles of heavy breakers in *fine weather*, succeeded by seven miles more in *heavy weather*, when the depth increases from five to ten fathoms, and where there is a great ripple and a heavy cross sea. The whole extent of this bar is 17 miles, beyond which the water gradually deepens.

Thus we have the Island, with its bars in bad weather, a continuous line of over 50 miles of foaming breakers, producing the most terrific effect; the Island seeming to shake to its foundation as the whole body of the Atlantic breaks upon it.

In addition to this bar, at either extremity there are three submerged bars, or ridges, parallel with the shore on both sides, with only a few feet of water, which form heavy breakers when there is any sea running, making it exceedingly hazardous for landing in boats.

On the south side the water deepens very *gradually*, thus extending its dangers far into the sea in *that* direction. Vessels seldom anchor on the south side, because of the prevalent swell from the south, and from the great distance from a landing, which is only practicable after a long continuance of northerly winds. While on the *north side* boats can only land during *southerly* wind and after a continuance of fine weather. But there are surf-boats belonging to the Island which can generally communicate when *ordinary* boats would swamp.

On the north side vessels anchor from one to two miles off shore. The bottom being fine sand, holds *well*, but the sea is so heavy, except in off-shore winds, that on the first indication of wind from the sea, a vessel must weigh anchor immediately and make an offing.

Wrecks on the N. W. or N. E. bar are of course far more dangerous to life than those that take place on the Island. In bad weather the rescue of a crew on the submerged portion of those bars would be impossible.

We have here a *chart* showing the wrecks that have taken place since the formation of the establishment by the Government, in 1802, for life-saving purposes, which I have compiled from official reports, and submitted to the three superintendents that have had charge of the Island. This chart shows the name and position of *known wrecks*. The unknown, on the bars, are, perhaps, far *more numerous*. After gales, and a long continuance of foggy weather, there are often sad evidences of disaster in the wreckage, and frequently bodies drifted on shore, of which nothing more is ever known. These bars, on the north side, are extremely steep, especially so the N. E. bar, having as much as 30 fathoms water close to it; hence a vessel caught here in a S. W. to S. E. gale, would probably strike, forge over and founder in deep water, leaving nothing whatever above to tell the tale.

In the immediate neighbourhood of the ocean little else but sand is seen, thrown up into every variety of drift, or scooped out by the wind into bowl-like hollows, relieved only by the stark timbers of many an unfortunate ship, washed by the waves or thrown high upon the shore, and the unceasing headlong plunge of the breakers, as each in turn rears its green head and breaks in a crest of foam as it rushes up the sloping beach. As we mount the hummocks and descend into the lake valley, the scene changes to that of a Western prairie. Desolate wastes of sand give place to green knolls and waving meadows of tall, luxuriant grass, interspersed with wild pea. In the vicinity of the lake can be gathered in their season *wild roses, lilies, asters, strawberries, blueberries, cranberries*—the latter affording quite a revenue to the Island.

Herds of wild ponies dot the valley and hill side. Here and there are fresh water ponds, girt with dense rank grass, where wild duck and water-fowl breed in thousands. Here, again is a long barren, known as the "desert," whose sands are as shifting as those of the Sahara, and equally as destitute of vegetation.

Thus alternate barrenness and vegetation, fertile valleys and sand hummocks, the entire length of the Island.

The Government establishment on this Island consists of a superintendent and 18 men, located at different parts of the Island. Besides the main station, there are five *out*-stations, where some of the staff reside. There are also two houses of *refuge*, in which are fire places filled with wood ; *match-boxes*, a *bucket*, and a *bag of biscuit*, hanging against the wall, out of reach of rats, which sometimes infest the Island. The door is simply latched. Written directions are posted up, showing the way to the stations, and how fresh water can be had by digging 18 inches in the sand. Many a crew, thrown on this desolate sand-bank in storm and darkness, finding their way to those houses, have had reason to bless the government for its thoughtfulness in providing for their emergency, without which many a poor fellow would have had to succumb.

At these out stations signal staffs are erected for the purpose of communicating with vessels or the *main* station, at which the row's nest on the cross-trees of the flag-staff has an elevation of 120 feet, and commands a view, in clear weather, of the entire Island.

During *fog* the island is patrolled once in 24 hours by roundsmen, or men from the outposts, on horseback.

Through the kindness of Miss DIX, who spent a short time on this Island, *four* Francis metallic life boats were placed at the different life-saving stations. There are also *surf-boats*, *rockets* and *mortars*, for throwing lines to wrecks, a *life-car* and *bretches buoy* for the landing of crews.

At the different stations there is a supply of tame horses always on hand to convey the boats to the vicinity of wrecks.

The life of the surf-men, though somewhat monotonous, is not an idle one. Each day has its duties. In fine weather their time is occupied in keeping the stations in repair, hauling firewood, attending to the domestic cattle, and farming in its season, besides landing supplies, and shipping wrecked materials on the visit of the Government steamer, and at stated times they have rocket and mortar drill, &c. In foggy weather, or after a storm, the watching of the beach for wrecks claims their whole attention.

Mounted on his pony the patrol wends his way, frequently in the teeth of the blast that almost sweeps him from his saddle, while often snow, hail and sleet—and oftener *still*, sharp sand drift, that cuts the face until smarting with pain—forces him to take shelter between the sand hills, and follow along the central valley, ever and anon mounting the hummocks to look seaward, and betimes plunging down into the land-wash to examine some object floating in the breakers — a spar, an empty bottle, or perhaps a hen-coop. Such tokens are often all he finds. And so he trudges on for miles. At length he discovers the next patrol approaching: they draw rein, exchange notes, *turn* and *retrace* their steps to report at head quarters. Thus patrols make the circuit of the Island.

The *horses* found wild here have been considered by Dr. GILPIN and others to resemble the wild horse of *Mexico*. It is generally thought that they were landed from some Spanish wreck. They are small, but *strong* and *active*, and show a power of endurance almost *surprising*; withstanding the inclemency of winter without other shelter than that afforded by the hillocks of sand.

The English *rabbit* has at different periods been very numerous, and threatened at one time to over-run the Island. But, to their *misfortune*, the Norway *rat* landed from an old vessel, and in a short time became so numerous that they nearly *annihilated* the rabbits, and then turned their attention to the stores of the Island, so that during *one* winter the staff were without bread for some months. In the spring the Government sent a detachment of cats to look after the *rats*. The *cats* killed the *rats* and then finished the remaining *rabbits*. In a short time the cats became so *wild* and *numerous* as to be a source of danger, when *dogs* were sent to hunt the cats, and with the assistance of shot guns in the hands of the staff, the cats were finally extirpated.

Again the Island was stocked with rabbits, when a *snowy owl* found his way thither, and being so delighted at his *find*, *disappeared*, and in a few days returned with his *friends*, who remained long after the rabbits were extinct, and still shows his kind remembrances by making periodical visits.

Until 1814, herds of wild *hogs* roamed the Island, which became *exceedingly fierce*, often attacking the cattle. But during a very severe winter all perished. Since that time this species of stock has not been allowed to range the Island, since, owing to their proclivity to hunt bodies in the sand, and devour those found in the land-wash, they became objects of horror and *disgust*.

The *walrus*, or *sea lion*, once repaired to this Island in large numbers. Their tusks are still being washed out of the sand, although they disappeared many years ago.

Early in January the Greenland seals make their appearance on the bars, for the purpose of *whelping*, and are sometimes hunted by the staff. The male is about 8 feet long, weighs often 800 lbs., and swims at the rate of seven miles an hour. They are very tenacious of life, often surviving the most severe wounds. Their habits are very interesting. When on shore they live in families, each male attended by several females.

The young at twenty days are nearly white, and those who have partaken of their flesh, pronounce it equal to that of sucking pig. When the males are old they are deserted by the females, and living apart from the rest, become exceedingly fierce. In their encounters they inflict on each other wounds like sabre thrusts, and after their engagements throw themselves into the sea to wash away the blood. The hunting of this species of seal is not without its dangers. They often turn upon their pursuers, and will sometimes ward off a blow, seize the club in their tusks and escape.

The common *harbour seal* is a constant dweller on the Island. In May their new-born whelps may be found sleeping on the sand in velvet coats, or riding the surges on their mothers' backs.

LIGHTS.

In 1873 the Government erected two powerful lights—one on each end of the Island—at a cost of $80,000, the propriety of which has been very much questioned.

Nearly every government that has come into power has had the subject of light houses on Sable Island before them, and as often has it been opposed by sea-faring men, who maintained that it would render navigation more dangerous than before. Their argument being that were no inducements offered to approach the Island, vessels would keep at a sufficiently safe distance from it; whereas, in the hope of making the light, they would be drawn near the bars, thereby increasing the risk and danger.

Some maintained, on the other hand, that if two powerful white lights were exhibited—one *fixed* the other *revolving*—they would be visible twenty miles, which would be quite far enough to warn vessels of their danger, and enable them to define their position. Mr. HOWE, in his report of 1848, stated that although Capt. DARBY and Mr. CUNARD entertained the belief that a light would induce vessels to run for the Island, and lure them amid shoals and sand-bars, it was, in his opinion, strongly advisable that a light should be erected near the central station, and that vessels not bound for the Island, nor driven there by currents or stress of weather, would no more run for it than they do now,—that they would, in fact, keep clear of it, it having no harbour of refuge; and that vessels outward bound would not require a new point of departure, while those homeward bound had all the coast before them; and if made to revolve E. and W., it would show in which direction the bars lie, and to government vessels it would be of great service. But, as before, no further action beyond debating the matter took place—at that time.

Foremost among the dangers surrounding this Island is that arising from the irregularity of the marine currents that sweep its shores. To trace the origin of which let us turn our attention for a while to the course of the gulf stream and polar current.

By glancing at Maury's Physical Chart, it will be seen that the gulf stream, after discharging its heated waters through the channel formed by the coast of Florida on the one side and Cuba and the Bahamas on the other, follows the trend of the American coast northward until approaching the shoals of Nantucket, where it swerves to the N. E., passing south of Sable Island to the tail of the great bank of Newfoundland, and then stretching over to Europe in a due east direction.

In opposition to this, we have the cold, ice-laden current of the North, one portion of which, after leaving the Arctic ocean, passes southward along the eastern coast of Greenland, where being joined by another branch coming from Baffin's Bay and Davis' Straits, it passes along the coasts of Labrador and Newfoundland to the great banks, where it is met by the northern edge of the gulf stream. At this point a division of the polar current takes place,—one portion, from its greater density, sinks below the warm current of the gulf stream and continues its course southward as a sub-marine current. This has been doubted. In the Transactions of this Institute for 1865, is a letter from Admiral MILNE to the President of this Society, concerning the currents on the N. E. coast of North America, in which he says: "This polar current passes along the east coast of Newfoundland as far as Cape Race, where a western part runs round it into St.

Mary's Bay, but the eastern part becomes lost. It is probably checked by the northern limit of the gulf stream, and turned into a more N. E. direction."

In that same year, however, it is recorded by Carpenter, that while laying the Atlantic cable in lat. 51° N., and lon. 38° W., a heavy storm came down upon them, and they were obliged to cut the cable. A red buoy was attached to it by a long wire rope, which, however, soon after broke loose and drifted away. Seventy-six days after this buoy was seen by a West India mail steamer in Lat. 42° N., lon. 40°; having travelled due south 600 nautical miles, a rate of about eight miles a day, directly against the gulf stream and prevalent winds, which can be only accounted for by the fact of the great length of wire rope that was hanging in the deeper polar current.

This has been further demonstrated by deeply-submerged icebergs being carried into and *across* the gulf stream, and being seen repeatedly as far south as 36° lat., by which it is inferred that the deeply-immersed portion offered more resistance to the lower current than to the shallow surface current, and was thus borne southward *across* the gulf stream.

The other portion of the polar current, when it impinges on the gulf stream at the great bank, becomes deflected to the westward, partially by contact with the great bank, and in its course its northern edge sweeps around Cape Race, into St. Mary's and the other bays north, until losing momentum it falls back and joins the main body of the current. This portion, sweeping around and into those bays, is commonly called the indraught by mariners, and to it, being accelerated by certain storms, is attributed the loss of the "Cedar Grove," at Canso, and the Cromwell boats at Cape Race.

The southern edge interlaces the gulf stream, and carries western bound vessels at such a rate as frequently leads mariners to miscalculate their position with reference to this island; to which fact are attributable many of the wrecks.

Capt. Darby, a former superintendent of the Island, in a letter to Blunt's Coast Pilot, with regard to the strength of this polar current says: "The most of the wrecks occurring here arise from error in longitude. I have known vessels from Europe that had not made an error of one-half degree in their longitude until they came to the banks of Newfoundland, and from there in moderate weather and light winds have made errors from 60 to 100 miles." It is difficult to understand how that commanders of vessels, making voyages to and from this country for so many years, should be apparently so ignorant of the strength of these currents, unless, as it would seem, they have periods of comparative quiescence and activity.

Then, again, we have a third current—a portion of the polar current, which, becoming detached at the southern end of Labrador, and sweeping through the Straits of Belle Isle, is joined by the vast flow of the St. Lawrence, and forms what is known as the Gulf of St. Lawrence current. This combined current skirts the east side of Cape Breton, passes south, and strikes obliquely in the vicinity of Sable Island that portion of the polar current which is deflected westward by contact with the banks of Newfoundland.

To these opposing currents, then, must be attributed those dangerous marine disturbances off our coast, of which Sable Island seems to be the centre. Capt. CLOUE, of the French navy, remarked that during his survey of the Quero bank, adjoining that of Sable Island, nothing surprised him more than the strength and uncertainty of the currents, which often set in a contrary direction to the prevailing winds, and change all round the compass in 24 hours.

This, of course, is in accordance with well-known law. Currents of water, like currents of air, meeting in opposite directions, produce eddies and swirls of the most conflicting character.

In February, 1803, the first superintendent, having had three months of anxiety from the rapidity with which the Island had washed away in the vicinity of his house, and having lost much of his provisions from the depredations of rats, and fearing that *want* would stare him in the face before relief would reach him in the spring vessel, built a dispatch boat and sent her out crowded with sail before a S. E. gale, in hopes that she would reach the main land, or be picked up by some inbound vessel that would carry the dispatches to the Government, and acquaint them of the starving condition of those on the Island. To his surprise, in 13 days *after* she returned to the beach, six miles above where she set out from.

This swirl motion around this Island is very marked. In calm weather an empty barrel or cask will make circuit after circuit of the Island, and this experiment is often resorted to for testing the velocity of the current. Again, bodies from wrecks have often made the same circuit, and it is quite customary for the surfmen to search on the opposite side for things which in consequence of an off-shore wind, have been carried thither by the current, and deposited upon the beach. During the prevalence of stormy weather these currents become terribly conflicting, and if accompanied by high tides, often remove by their eroding action, hundreds of feet from the embankments Then again, danger often arises from the lowness of the shores.

Being *treeless* — with the exception of the light house having nothing to distinguish it from the surrounding ocean which it so resembles in colour—vessels have been known in a stiff breeze and clear weather to run *directly* for the Island without the slightest knowledge of its proximity, until their attention has been arrested by the red ensign flung to the breeze from the flagstaff at one of the stations. Often sailing vessels and mail steamers are seen from the Island in positions clearly showing that they were unaware of its presence.

Fogs of a density seldom experienced elsewhere are prevalent all the year round, and accompany all winds from N. E. round by south to S. W. The warm, moist air from above the gulf stream meeting the cold air above the polar current, is condensed into fog which gives but little warning of approach, and contributes in a marked degree to the dangerous surroundings of this Island.

Another danger arises from its proximity to the gulf stream. Ask the mariner where he most dreads to encounter the storm, and perchance he will answer on a lea shore or the northern edge of the gulf.

Maury, who made a life study of the stream, says: "With such elements of atmospheric disturbances on its bosom, it follows that storms of the most violent character would accompany it in its course. Accordingly the most terrific that rage on the ocean have been known to spend their fury on its northern border."

There have been some memorable tempests here which have marked, as it were, *periods* in the history of this Island,—nights of terror never to be forgotten. The inhabitants of this lonely, desolate sand-bar have often despaired of ever seeing the dawn, and sat speechless for hours, listening, terror-stricken, to the howling of the blast, which threatened every moment to hurl their dwellings from their unstable foundation into the seething ocean. On one occasion, on going forth after such a night, they were horrified to find that, in addition to the transformation undergone around them by the removal of sand-hills, and the creation of others, that a portion equal to 3 miles long, 40 feet wide, and from 20 to 60 feet high, had gone bodily from the north side of their Island. This now forms one of those parallel bars over which the sea in storms breaks in terrific tumult. The awful violence, as well as the suddenness of those storms, which are cyclonic in their character, form one of the most remarkable phenomena of this Island..

The sun often rises clear, giving indications of continued good weather, and, with the exception of the sea breaking high on the bars, and the fretful moan of the surf as it breaks along the shore, there is no premonition of the coming storm. Suddenly a dull, leaden haze obscures the sun: clouds gather from all directions. The sky assumes a wild, unusual appearance. The wind begins to rise in fitful gusts, carrying swirls of sand before it. The darkness increases as the low, driving scud shuts in all distant objects. Now the gale bursts in awful fury, whipping off the summits of the hummocks, carrying before it a cloud of blinding sand-drift. Darkness adds to the horror of the scene, while rain descends in a perfect deluge. No human voice can be heard above the tempest. The crinkled lightning for an instant lights up the mad waves, as they rear and hiss along the beach. Then a sudden calm ensues,—as strange as calm. A few short gusts at first break this period of tranquility, and in a few minutes the hurricane bursts again from the opposite quarter. The darkness is still intense, relieved only by the red glare of the lightning, which is quickly followed by the crashing of the thunder, as it strives to be heard above the howling of the blast. Gradually the storm ceases, the clouds break and pack away in dense black masses to leeward, and the sea alone retains its wild tumult.

During such a tempest in 1811, thousands of tons of sand were carried from the beach—some from one side and some from the other, as the gale shifted—and strewn over the island, so that vegetation was nearly smothered, hundreds of horses died for want of food, and the outlines of the Island completely changed. Sand-hills that had formed land-marks were tumbled into the sea, and mountains piled where once were valleys; recent wrecks disappeared, and others brought to view of which there is no history.

It is interesting to note that while in several places in Great Britain they are at present making many and successful experiments in the way of lessening the dangers of harbour approach by pouring oil on the troubled waters, the utility of this has been demonstrated at this Island nearly 40 years ago, and although the superintendent, Capt. DARBY, gave every publicity to the circumstances, and pointed out its advantages, we have little evidence of it being adopted until the last few years.

As this oil theory is attracting so much attention of late, in Liverpool and other places, I will give you, in a condensed form, Capt. DARBY'S report of the saving of Capt. HIGGINS and his crew, as follows :

> "On the 19th of September, 1846, the Government schr. "Daring," commanded by my eldest son, came to the Island for the purpose of conveying to Halifax the crew and materials of the wreck of the ship "Detroit," lately stranded there with her crew and passengers; also the crew of the schooner "Lady Elcho," lately stranded there. We got the schooner down the north side to the wreck of "Detroit," about ten miles to the eastward of head-quarters, and commenced shipping her materials, and the work went on with vigour and alacrity. The day was moderate,

with light airs of wind from the eastward. It was a clear and cloudless day, but it had a certain dull appearance about it, that seemed to portend a gathering of the elements together, as if for strife. The sea ran high, although there was no wind, and gave us a good deal of trouble, by often filling our loaded boats in crossing the bars, where it often broke very badly, and rolled along the shore with a groaning and very troubled sound. After the sun passed the meridian the gloom and dulness seemed to increase, the sea rose higher, although but little wind, and the moaning sound of the waters as they broke along the strand, seemed to give strong indications of a coming storm. Our work proceeded successfully, notwithstanding the difficulties we had to contend with;—the property was all shipped, the vessel loaded and ready for sea, and at half an hour after sunset she got under weigh, with our boat and boat's crew to be towed up to head-quarters and landed there. The wind was now a fresh breeze from east. I got on my horse to keep abreast of the vessel, which I did until dark. I had ten miles to go to the landing place, I drove to that point as fast as I could, and then rushed on to the beach to watch the arrival of my boat. It was now very dark, with a fresh breeze, and the sea rising very fast. The whole ocean seemed to be in a phosphoretic blaze of light. I soon observed our boat coming directly towards me: I jumped off my horse, and as I always rode with six fathoms of line on my horse's neck, one end I fastened there, and the other end I tied to my leg. I was then able to assist my people in the boat without loosing my horse, as she filled and turned over just as she got within my reach. The people reported that the schooner hauled off to sea the moment that the boat left her. We hauled up and secured our boat for an approaching gale, then went to the house, changed our wet clothes, got supper, and set a watch. At midnight the watch reported heavy gale of wind from E. N. E.; at four o'clock the morning of the 20th, a most terrific gale of wind with rain from the N. E.; and at daylight the gale to be still increasing, and the wind veering to the N. N.E. All hands out. The hull of the schooner *Lady Elcho*, that had been wrecked near the landing, could be seen from the look-out house to be floating and knocking about on the beach, and we had to crawl on our hands and knees across the Island to where her cargo of barrels of mackerel was piled up,—the wind being so violent we could not proceed against it in an upright position. We found the cargo in danger of being smashed to pieces by the sea, and we commenced parbuckling it up the bank to a place of comparative safety, and were so occupied until about noon; and it was this circumstance that brought us all out there in that terrific gale, as if Providence directed that we should all be out and all together so as to be the better prepared for what was going to follow. All of a sudden, we saw an object off the North side dead to windward which we first thought was a large bird, but shortly after discovered that it was a sail distant five or six miles, and that she was running down right before this tremendous gale dead on a lee-shore. We could work no more at the barrels. Our eyes were strained in the direction of the object that appeared to be running to inevitable destruction. My first impression was that it was the schooner *Daring* which had left the Island the evening before, and that they had met with some disaster so as to disable the vessel in the gale, and were going to run her on shore before night to save their lives.

We could see that she was a schooner with a close-reefed mainsail set, steering directly for our flag-staff. I was convinced that it was my son, who with two of his sisters on board, and a great number of other passengers, were taking this method to preserve their lives. The sea was breaking everywhere off the North side as far as the eye could see, and it appeared almost incredible that any vessel could live to come so great a distance through such mountains of broken water. I got a rope prepared, to assist in preserving the people's lives should the vessel be able to reach the beach through the roaring and boiling mountains of water that surrounded her. When she approached within three miles of the land she appeared to be in the heaviest breakers, and we could plainly perceive mountain waves on each side of her that would raise their curled heads as high as the tops of her masts and pitch over and fall with the weight of hundreds of tons, either of which would have been sufficient to have smashed that frail bark to atoms; but, miraculous as it may appear, not one of them touched her. At one moment you could just perceive the heads of her masts between the mountains of waters that were smashing and breaking to pieces all around, but not permitted to hurt her; at the next moment you would see her on the top of a tremendous wave which appeared like certain destruction to her; at another, you would see a mountain sea rising up before her and breaking all to fragments in her path, but when she arrived at the spot the surface was smooth as glass. When she arrived within one mile of the shore she had to pass over what we call the Outer Bar, where every sea broke from the bottom, and our greatest anxiety for the safety of the vessel was at this point. The sea was there breaking with tremendous violence, but that heaven-favored bark passed through untouched,—the sea became smooth before her, and she left a shining track behind. Now, here was the miracle. I looked on this with wonder, awe and admiration, and not without hope. When she approached a little nearer, I could see one man lashed to the helm and two men forward lashed by each of the fore-shrouds, and by each man a large cask standing on end. We could also see that the two men were making great exertions with their arms, as if throwing something up in the wind. The vessel had now passed the most dangerous place, and her safety seemed certain,—I could breathe much freer than I had done for some minutes. Another half-mile brought her to the beach, and her bow struck the sand. From this spot to the high bank was about fifty or sixty yards over a flat beach, which was always dry except in heavy gales, but was now covered over with water. A number of heavy seas would roll together over the beach, and then recede, leaving it dry. Over this place myself and the men were extended with a rope leading from the bank down to the vessel's bow, on which we held to keep the sea from washing us away; and when the great body of water receded, we could approach as near as the jib-boom end, from which, one by one, the crew lowered themselves by a rope into our arms, and we passed them in safety to the bank.

"The Schooner was the *Arno*, Capt. HIGGINS, with twelve men, from Quero Bank, where they had been fishing. They left the Bank at the commencement of the gale. He had lost all his head sails when at daylight this morning he made the land dead under his lee, with the gale blowing right on shore. The vessel having no head-sail, he could do nothing with her on a wind. He let go his anchor in twenty fathoms of water, paid out three hundred fathoms of hemp cable, and brought the vessel head to wind. In that tremendous sea he held on until noon, when, seeing no prospect of the gale abating, he cut his cable and put the vessel before the wind, preferring to run her on shore before night to riding there and foundering at her anchor. He lashed himself to the helm, sent all his men below but two, and nailed up the cabin-doors. He had two large casks placed near the fore-shrouds and lashed there. He then directed his two best men to station themselves there and lash themselves firmly to the casks, which were partly filled with blubber and oil from the fish. They had each a wooden ladle about two feet long, and with those ladles they dipped up the blubber and oil, and threw it up in the air as high as they could. The great violence of the wind carried it far to leeward, and, spreading over the water, made its surface smooth before her and left a shining path behind; and although the sea would rise very high, yet the top of it was smooth, and never broke where the oil was. It was raging, pitching and breaking close to her on each side, but not a barrel of water fell upon her deck the whole distance. The vessel was so old and tender that she went all to pieces in a very short time after the crew, with their clothing and provisions, were saved."

With regard to this phospheresence of the sea, at times there are magnificent displays of it here. Among the early inhabitants it was the cause of much alarm, and augmented the many stories of the supernatural told in connection with the place. Its first appearance to one of the superintendents, is recorded in the journals of the Island as follows:

"Last night a singular phenomenon appeared on the south side. The sea being high, and the night very dark, the breaking of the sea would exhibit at intervals of from 5 to 10 minutes a phosphorescent light. In some places it would be seen through the gulches on the south side. When the beach was low, and the sea broke high, it would rise in a great bright light to the height of 15 or 20 feet, like an enormous fire, yet only to be seen at certain places at a time."

In other places it is spoken of as the sea being on fire.

It generally appears after much southerly wind, and is probably brought by the drift, or surface current, from the Gulf Stream.

In the short time allotted me this evening, Mr. PRESIDENT, I can but glance at the many interesting phenomena of the Island and its surroundings. These facts and incidences are such as I have been able to obtain from available documents, as well as from personal observation. From these facts I have deduced certain inferences, the plausibility of which I humbly submit to the judgment of the Institute.

On some future occasion I hope to present to you in detail what is, perhaps, the most interesting and important feature in connection with this Island, viz.—ITS CHANGED POSITION.

ART. IV.—GLACIAL TRANSPORTATION IN NOVA SCOTIA AND BEYOND.—*(Problem of 1873 solved.)* BY PROF. D. HONEYMAN, D. C. L., &c. *Hon. Member of the Geol. Assoc., London.*

(Read Feb. 12, 1883.)

[*Substance of this and of preceding Paper on the same subject, communicated to the Geologists Association of London at July meeting.*]

PICTOU COUNTY.

LAST summer I extended my observations from West River railway station, eastward as far as the Albion mines. Syenitic boulders were observed on both sides of the railway, as far as Hopewell station. At the new workings of the Albion mines I collected boulders from the drift—syenitic gneisses and syenites. The position of the drift having these boulders is intermediate between the Cobequid mountains and the Archæan rocks of East River. The source of the boulders is therefore problematical. They may have been brought to their present position by floods occurring at the close of the glacial period. One of the boulders is a very beautiful syenite. I found a large boulder of a similar character near Merigomish harbour in 1868. It was composed of white and pale red orthoclase, light green hornblende and hyaline quartz. I have not seen a syenite like it *in situ*.

ANTIGONISH COUNTY.

On the shore at Morristown, (Antigonish) boulders, large and small, of Diorite of strongly-marked character, attracted my attention upwards of twenty years ago. Much speculation was indulged in regarding their source. It was concluded that they had been transported from the Labrador coast.

When I discovered the typical "Archæan" Arisaig rocks on Northumberland Strait shore in 1868, I was pleased to find a rock precisely similar to the boulders in question as one of the rocks of the series. I may remark that in all my examinations subsequently of the Archæan rocks of Nova Scotia and Cape Breton, or elsewhere, I have not found another rock like it. On re-examining the shore where the boulders lay, I observed similar boulders rolling down the bank out of the drift which overlies the gypsums and limestones. I consequently concluded that the boulders had been derived from the Archæan rock on Northumberland Strait,—having been transported a distance of 10 miles. A line drawn on the Admiralty Chart from the position of the rock to that of the boulders on the shore, runs S. 20 E., N. 20 W., magnetic. This is parallel to the line of Blomidon amygdaloid transportation. This is a striking coincidence. It is also parallel to the intermediate glacial lines of Gay's River road and the Gore. *(Acadian Geology Table.)*

Further west in the Arisaig Township, we have the jaspideous rocks of Frenchman's Barn and of Arisaig Pier, transported southwardly; massive boulders being found landed on the higher grounds.

ADMIRALTY CHART LINES.

My working chart shows the Strait of Canseau running parallel with the extension of the Northumberland Strait and Morristown (Antigonish) Archæan transportation course, and all the Atlantic coast harbours of Nova Scotia, as far west as Ship harbour, approximately parallel. From Ship harbour to Halifax harbour the harbours follow approximately the course of lines made by local glaciers. *(See preceding Papers. Trans. 1875-6, and 1881. S. and E.)*

Halifax harbour and the estuary of the Avon are in the line of the Blomidon and Halifax glacier, which has transported the triassic amygdaloids. The Archæan transportation glacier converging on Bedford Basin. The Blomidon glaciation lines extended N. W., pass through the depression of the Cobequid mountains.

ANNAPOLIS COUNTY.

As I have noticed in other papers on general geology, triassic amygdaloids, from North Mountain, a continuation of Blomidon, were collected by myself in the drift cuttings of the

Nictaux and Atlantic Railway, on the S. E. side of Cleveland mountain, a part of which is called South mountain, on the south side of the Annapolis Valley. Near the front of Cleveland mountain (N.), an interesting exposure of glaciated argillites occurs where the old or steep road meets the new one. This position is nearly on a level with the general elevation of North mountain. This is the only striation that I have noticed on the north side of Nova Scotia. I remarked of this striation that the agent making it and transporting the amygdaloids from the North mountain, must have had a highway across the tract intervening between the two mountain ranges. I therefore inferred the *non-existence* of the Annapolis Valley in the glacial period.

I also noticed at Nictaux a transportation of granite northwards, from the granites of South mountain towards the Annapolis Valley. I have considered the amygdaloid transportation as during the glacial period, and the granite as occurring towards its close during the formation of the Annapolis Valley, the granite having been transported by ~~s~~and-slips or avalanches. l

KING'S COUNTY.

In the middle of the Annapolis valley, near the Berwick station of the Windsor and Annapolis Railway, numerous boulders of granite were found. These, too, have been transported northerly from the granite region of South mountain. The time of transportation, and the agency, may possibly have been the same as referred to in the preceding case.

At Kentville, trappean boulders from the North Mountain were observed, and a beautiful specimen of fortification agate collected.

On the south side of Wolfville—on the side of the road that passes Acadia College—abundance of amygdaloids and other trappean boulders were observed. At the south-east they were very abundant, near, and in the Gaspereaux Valley. The size and number of these were such as might be expected in sight of Blomidon, and without any apparent obstruction in the path of transportation. I was disappointed, however, in observing their rarity in the space intervening between Wolfville and Blomidon. I do not recollect of seeing any trappean boulders until approaching the latter. I found on Blomidon the amygdaloid rocks,—the source of supply—far from exhausted by the enormous levy that had been made to supply so liberally the drift between Wolfville and the Atlantic.

I noticed, also, another great granite transportation. Granite boulders were first observed in Halfway River, at the line between the Counties of King's and Hants. Approaching their source, the extension of the granites of South mountain, already referred to, the size and number of the boulders was so great as to lead to the belief that the solid granite was underneath, while the underlying rocks were found to be argillites. The transportation is like the cases already referred to northerly. Amygdaloids of the southerly transportation were also observed among the granite boulders among the argillites of Greenfield.

HANTS COUNTY.

On the estuary of the Avon, from Horton Bluff to Windsor, amygdaloids are seen in great abundance, and often of considerable size. Besides the lower carboniferous limestones, above the old Avon bridge are abundance of small amygdaloid boulders. It was when examining these limestones, and collecting their fossils, in 1861, that I first noticed the amygdaloid boulders. Prof. How then informed me that they were from Blomidon. On every subsequent visit to this locality, I made a more intimate acquaintance with them and their minerals. It was this acquaintance that led me to recognize their fellows at Cow Bay and elsewhere.

BEYOND.

While some of the movements were undoubtedly local, others —*e. g.*, the Archæan transportation of Antigonish—could not possibly originate on the border of Northumberland Strait. This conviction left me to consult the record of observations made in Canada by Sir WM. E. LOGAN and others, in the table of glaciation grooves in "Geology of Canada, 1863." Pp. 890, 1–2. Here I found Nova Scotian courses S. E. prevailing over S. W., up to

Lon. 80° 54, in the ratio of 2·1. This convinced me that the Nova Scotia courses were part of a system having their beginning in the distant N. W. To illustrate the relation of these to the general transportation of Nova Scotia, S. E., I added a sheet to my chart, so as to be able to locate the groove lines of the table as far as Lon. 38° W. The illustration is very striking. The variations from the S. E. course are probably like those of Nova Scotia,—deviations arising from local causes.

About the 80° meridian the arrangement of glacial lines is peculiarly striking. Here we have a point of general divergence. West of this the glaciation has a S. W. course, S. E. lines being the exception.

Lake Temiscamang has 10 localities with S. E. striation. East Bay of this lake, Lon. 79° 30, seems to be about the point of divergence. Here the striation has a course S. 53° E. Beyond the lake the courses are S. W. This is one of the lakes of Ottawa river. The sources of the river lie to the north of it. nearer Hudson's Bay. Lake Nepissing, S. E. Bay, Lon. 79° 33 has striation course S. 35° W., and a westerly water course, so that the point of glacial divergence seems to be also that of water.

Last summer I had repeated opportunities of making a *reconnaissance* of the superficial and other geology of the region traversed by the Intercolonial Railway as far as Point Levis. I observed frequently boulders which doubtless were transported from the Archæan region north of the River St. Lawrence.

OTTAWA.

At Ottawa I made a closer examination of Archæan transportation when making acquaintance with the geology of the district. On the Rideau river, at the shooting range, I examined the large boulders lying around. The majority of these were gneisses, and foreign to Trenton limestone and Utica slate of the district. There were boulders of syenite, diorite, granite and syenitic gneisses. One syenitic gneiss boulder was replete with magnetite. Of these I secured Museum specimens. In Sir W. E. LOGAN'S table, there is reported striation at Barrack-hill, having a course S. 45° E., and at Rideau river, Stegman's rapids, S. 45° E. I located and extended this striation course on VENNOR'S map, and found it to run between the Hull and LAYCOCK'S Iron Mines, situate in the Laurentian (Archæan) range to the north of Ottawa, where we might expect magnetite to exist in gneisses. In the same table there is striation noted at Hull, having also a course S. 45° E.

KINGSTON.

I had also an opportunity of making a *reconnaissance* of the Geology of Canada between Montreal and Kingston, and between Kingston and Ottawa. The Archæan, near Kingston, with the Trenton limestone directly overlying it, was a point of special interest observed. When preparing the Nova Scotia department at the Dominion exhibition, I observed numerous and massive Archæan boulders on and around the exhibition grounds. These very much resembled the Ottawa boulders, being granitic and syenitic gneisses, syenites, &c., transported from the Archæan region on the north. Specimens of these were also collected for the Museum. Among the boulders was a piece of Trenton limestone, beautifully glaciated. Of this I also secured a specimen. In my search for glaciation, I observed Trenton limestone, deeply furrowed, near the entrance to the Royal Military College. The course of the furrows was found to be S. 45° W. In Sir W. E. LOGAN'S table there is Kingston lat. 44° 14′, lon. 76° 29′. Direction of grooves S. 45° W., other grooves S. 85° E. I observed the phenomena of glacial transportation to a distance of 3° short of the longitude of Lake Temiscamang. The longitude of Archæan transportation of Antigonish being 61° 53′; the field which I here traversed and found boulders by Archæan transportation is 14° 36′ from east to west. The great transportation lines of Nova Scotia extending N. W., reach Hudson's Bay at James' Bay, on the east side.

In my investigations I have thus added to the region of Canadian observers the Province of Nova Scotia, and given the great south-eastern transportation of North America an Atlantic terminus.

BOULDERS.

On New Year's day, Mr. NOLAN, whose name has already been mentioned in connection with Observatory Hill, H. M. Dockyard, showed me a boulder broken into four pieces, as something interesting. The boulder is of triassic amygdaloid. Its colour is gray, its amygdals are numerous; their minerals are heulandite and stilbite. It is altogether a striking specimen. The piece in my possession weighs 12¾ lbs. The weight of the whole seems to have been about 25 lbs. It has been an associate of Observatory Hill amygdaloid boulders referred to in a preceding paper. Its character is unmistakable. The North Mountain, Blomidon and Five Island rocks are the only series in British America that could produce it. The striation in the vicinity of the Dockyard points to Blomidon as the locality whence it came, I have already referred to rocks of Blomidon as similar to our boulder. I have no hesitation in affirming that this boulder and its associates have travelled over-land from Blomidon, a distance of 64 miles. While I believe this, I can excuse the incredulity of those who are not educated to appreciate the convincing nature of the evidence upon which my faith is founded. As I survey the present appearance of the way over which our boulder has travelled, its transit appears to be an evident impossibility. To prepare a way for its passage, we assume that there are heights, hollows and dead level, where in pre-glacial times there was necessary altitudes and more or less incline. To restore this state of things I made two postulates: 1st. That all the boulders and rock detritus which were carried from their original position and cast into the Atlantic, or scattered broadcast as we have found them over the length and breadth of the Province, should be restored to their pre-glacial position. 2nd. That the action of post glacial agencies should be annulled. We can then see in the visions of the past a great highway over which special agencies of speculative character advance, it may be slowly but surely, and irresistibly in a S. E. direction, accumulating freight in their progress and discharging into the Atlantic. Then in process of time the same agencies are seen in their alternate retreat, advance and retreat, unloading their freight, raising drift accumulations, and obstructing or destroying the great highway so as to render it impossible for any like agency to accomplish similar work. This is the condition in which we now find it, unless where the condition has been aggravated by the operations of agencies at work in post glacial times.

HISTORY OF THE PROBLEM.

In the summer of 1872, Judge (in Equity) JAMES showed me, in the Museum, a beautiful specimen of agate, which he found at Cow Bay. I recognized it at once as an agate from the Blomidon series of rocks, and said so. I thought no more about it. On the 24th of May the following year—the Queen's birthday—I went to Cow Bay with my late lamented friend—W. S. STIRLING, Esq., of Halifax, to spend a holiday. Wandering along the shore, my attention was attracted to the amygdaloid boulders washed by the sea. I recognized them as Blomidon rocks. Their occurrence here was perplexing, until abundance of like boulders and a beautiful specimen of agate, were seen and collected out of the lofty section of drift on the east side of the bay. Masses of quartzite, curiously furrowed, also fallen from the drift, suggested a connection with the striation of Point Pleasant. An interesting problem in glacial transportation thus presented itself for solution. I forthwith commenced investigations. I communicated two papers to the Institute containing the results of these investigations. One was read in December, 1875, and the other in March, 1876. At the request of my friend, Prof. LESLEY, the substance of these was communicated to the American Philosophical Society in May 16, 1876. The Paper was illustrated by a sketch map, and an extensive suit of boulders, derived from the various formations over which the transporting agent had passed. This collection, of which there is a list in my paper read to the Institute "On Nova Scotian Geology at the Centennial Exhibition of Philadelphia, 1876," was awarded a prize medal by the International Judges of Class I. Further investigations were recorded in my paper "On the

Geology of King's County." *Trans.* 1877-8. In my paper "On the Superficial Geology of Halifax and Colchester Counties," read last session, I recorded other investigations. In the present paper is a record of the last steps which I consider necessary for the solution of the problem. By going *beyond* Nova Scotia, I have done more than I expected to accomplish.

ART. V.—AN ANALYSIS OF A PICTOU COAL SEAM. By EDWIN GILPIN, JR., A.M., F.G.S., M.R.S.C. *Inspector of Mines.*

(Read April 9, 1883.)

THROUGH the courtesy of Mr. H. A. BUDDEN, Vice-President of the Intercolonial Coal Mining Company, I am permitted to lay before you the following analysis of a seam of coal, recently opened by them at Westville, Pictou County. Through the kindness of Mr. ROBERT SIMPSON, General Manager of the Company, who furnished me with a complete column of the seam, I was enabled to make a very careful and exact measurement of the various layers comprising the seam.

The following is the section of the seam in inches and tenths of an inch, beginning at the top:—

	INCHES.	INCHES.
Coal, coarse and shaley		5·4
" good, with two thin layers of shale, each 1-20th of an inch thick	4·4	
" good, but coarse	6·7	
Shale		·2
"		1·7
Coal, good	6·3	
" shaley, with nodules of iron pyrites.	·5	
" good, with four bands of shale, up to one-half inch thick	1.4	
Shale		·6

	INCHES	INCHES
Coal, with bands of shale	....	·9
" good	4·7	....
" coarse and shaley	·8	....
" coarse	·8	....
" good	2·8	....
" " with several fine layers of shale	1·2	....
" "	5·6	....
Shale, with films of calcspar	....	·2
Coal, good	4·8	....
" with layers of shale	....	·9
" coarse with nodules of iron pyrites	....	2·8
" good, with films of calcspar	4·0	....
" with layers of shale	....	1·8
Shale	....	·1
Coal, good	6·0	....
" shaley, with films of calcspar	....	3·0
" coarse, with spirorbis, etc.	....	1·0
" shaley	....	·2
" good	9·8	....
" coarse, a few layers of shale	2·0	....
" good	2·0	....
" good, with films of calcspar, and a few nodules of iron pyrites	7·1	....
Shale	....	·1
Coal, good	13·2	....
" " with layers of shale	·2	....
" " with a few nodules of iron pyrites	13·0	....
TOTAL	*Coal* 97·3	*Shale* 19·0

This succession of layers presents some points of interest on which I would say a few words.

In no point do coal seams differ more than in the number and size of the included layers of shale. The Vale seam, in Pictou County presents, at numerous points through the mine, a section in which no bands of shale can be detected. Other seams contain them in varying proportions, sometimes to such an extent that the coal is rendered valueless for economic purposes· Almost the only value these bands of shale possess, is their record of the progress of growth of the associated coal. Applying the record of the numerous small bands of shale and shaley coal found in the seam under consideration, we learn that the growth of this deposit was not an uninterrupted one. Scarcely had the vegetation for a few inches of coal been accumulated, when a change took place, and it was covered by a layer of mud.

It is useless, perhaps, now to speculate how this covering was formed, perchance the shelter of some bar was broken, and for a season the tides could deposit their burden, or some nameless river of bygone days became obstructed and flooded the swamps, in which grew the weird vegetation of the carboniferous era.

Then, again, the vegetation accumulated to be once more interrupted. The presence of layers of coarse and shaley coal shows that the transition from a flourishing vegetation to a mud-laden flat was, in some cases, a gradual one, due, perhaps, to periodic inundations. Similarly the return to the conditions favourable to the growth of the coal plants was sometimes a slow one, as the struggle between land and water was year after year more and more in favour of the vegetation.

Thus grew our coal deposits, subject to the fluctuations of the district, and when the miner's pick thus reveals page after page of this wondrous history, it is not unreasonable to hope that some time they will be deciphered even more readily and with greater certainty than the changes now progressing around us.

So far as I am aware, it is noticeable that in all seams these layers are composed of very fine material, that never have the conditions of growth been so abruptly altered as to allow gravel or conglomerate to intervene. Such intercalations might, however, be observed in seams formed on the edges of productive districts where changed physical conditions held sway. So strongly marked were the general conditions of wide spread levels of vegetation during the productive period, that we find, even when oscillations permitted streams to cut through coal beds, they carried only the finest sediments. An illustration of this recently came under my notice in the Cumberland district, where a brook of the carboniferous period had eroded the coal down to and partly through the underclay, the "want" being filled with a fine laminated gray shale. This is also interesting, for from the abrupt passage from coal to shale it is apparent that even at that early date in the history of the future coal bed it must have acquired a certain amount of coherence, enough to form the banks of even a sluggish stream.

There is another interesting point in connection with coal seams which I have not yet seen referred to in any books on this subject. That is the influence of the water and land surrounding the coal producing district upon the purity and homogeneity of the resulting coal bed. It is frequently found by the miner that, as he follows the seam, it changes its character. At first he was proud of the absence of "bands and balls" and of the facility with which he could supply pure coal. Gradually he finds that the bands of shale grow larger with ominous persistence. At last he awakens to the fact that his coal is getting "boney;" finally it proves unmarketable, and he turns his levels in another direction.

Sometimes trial-pits and bore-holes in advance prove that the coal has become a mere mass of carbonaceous shale, or that the seam has ceased. These changes may frequently be explained by the proximity of the vegetation to an arm of the sea or to a river, so that the deposition of mud from floods, etc., at first slight, becomes greater, both in the form of bands, and of a general addition of clayey and silicious matter. Finally a point is reached where the conditions of coal deposition ceased. In some cases the proximity of land covered by sand, which was carried by prevailing winds upon the accumulating vegetation, may explain the presence of an excessive amount of ash in seams not holding bands of shale. It may also have been possible that both these causes united to the deterioration of seams of coal.

This would show that some of the beds were formed in what might be termed broad shallow basins, in the centre of which is found the purest coal, and that it gradually deteriorates each way. The presence of "barren" intervals is of importance, for much money has been spent in examining and proving these marginal districts, when a step further might have resulted in the discovery of workable beds.

The coal from this seam presents a finely-laminated appearance, with a fairly bright lustre, and breaks readily along the deposition planes, which are of a dull black colour, and hold a good deal of mineral charcoal. It is strong and forms little dust or slack. The coal is divided by two cleavage planes, obliquely inclined toward each other, causing it to break into rhomboidal pieces. It is comparatively free from iron pyrites, which is present in small nodules in several divisions of the seam.

The following proximate analyses were made by me on the fresh mined coal carefully sampled as it came from the face. The seam was divided into two portions,—the top comprising 34·4 inches, the lower 89·9 inches.

	Top Coal.	*Low'r Coal.*
Moisture	1·24	·95
Volatile combustible matter.—Fast coking	31·00	23·31
" " " Slow "	27·56	20·52
Fixed Carbon Fast "	46·23	60·29
" " Slow "	49·67	63·08
Ash	21·53	15·45
Sulphur (from pyrites)	·63	.939
Specific gravity	1·50	1·390
Theoretical evaporative power—Fast coking	6·35	8·28
" " " Slow "	6·83	8·66

The ash from both divisions is the average of two determinations, and is silicious, and of a light gray colour. The specific gravity is from the average determined for each larger layer of coal. The coal in each division did not coke by slow heating, that from the lower division was fairly coherent by fast heating. It may be remarked that an opinion as to the economical coking values of coals formed on their action in the crucible cannot be relied upon for a guide as to their yield in practical coking.

It will be noted that the percentage of ash in the top coal injures its use for general purposes; it can, however, be utilized for colliery work, to the economy of the better coal. The coal from the lower portion is equal to the average of that mined in Pictou County. The theoretical evaporative power compares favorably with that of the coals from the various counties of the Province, as will appear from the following table:

Pictou Co'y,	average of	5	coals.	Theoretical	evaporative	power	8·66
Cumberland Co.,	"	3	"	"	"	"	8·32
Cape Breton "	"	12	"	"	"	"	8·56
Inverness "	"	2	"	"	"	"	7·60

The average evaporative power of the lower part of the seam under consideration is 8·47. All the evaporative powers are calculated by REGNAULT'S formula, for comparison with the admiralty coal trials, although later researches have somewhat altered the values determined by him. The table is taken from the analysis given in my paper on "Canadian Coals," published in the transactions of the North of England Institute of Mining Engineers, for the year 1878.

ART. VI.—ON THE RESISTANCE TO THE PASSAGE OF THE ELECTRIC CURRENT BETWEEN AMALGAMATED ZINC ELECTRODES AND SOLUTIONS OF ZINC SULPHATE. BY PROF. J. G. MACGREGOR, M.A., D.Sc., F.R.S.E.

(Read April 9th, 1883.)

AFTER attention had been directed to the measurement of resistance by the establishment of OHM'S Law, the question was raised whether or not there was at the surface of separation of conductors of different substances a special resistance to the passage of the current, such that the current was weakened by the mere transition from the one conductor to the other. POGGENDORFF* settled this question for metals by so arranging two circuits whose parts had the same aggregate resistance that in the one there was a single passage from one metal to another, in the other several such passages, and finding that the resistances of the two circuits were the same.

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*Pogg. Ann. LII (1841).

In the case of electrolytes there may be not only the form of transition resistance mentioned above, but also another arising from the chemical decomposition which the current effects. Even when no solid or liquid substances are deposited on the electrodes and no gas is given off from them, there is usually some change produced by the current in the surfaces of the electrodes, for they are usually polarised. It is possible therefore that the very process of electrolysis may give rise to such a state of the surfaces of the electrodes that the current is weakened in passing across them.

These two possible forms of transition resistance are usually spoken of together under the one name, there being no experimental means of separating them. The determination of their existence or non-existence is rendered difficult by the fact, that the passage of the current through an electrolyte modifies the resistance of the electrolyte by changing its constitution, and changes the electromotive force of the circuit by producing polarisation.

LENZ† and POGGENDORFF* thought to eliminate polarisation by the use of rapidly alternating magneto-electric currents; and the latter, basing on this assumption, not only regarded the existence of a transition resistance proven, but made an investigation of its laws. VORSSELMAN DE HEER,‡ however, has pointed out that this assumption is not only unwarranted but shown by experiment to be inaccurate. I have arrived at the same result in some experiments made to test the method which KOHLRAUSCH and NIPPOLDT used to measure the resistance of electrolytes. Although I made 250 currents per second pass through various saline solutions from a magneto-electric machine which was made to work with great regularity, yet a sensitive galvanometer gave quite large deflections due only to polarisation of the electrodes, and that, however long or however short the time during which the alternating currents were allowed to pass through the electrolytic cell.

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† Pogg. Ann. XLVII (1839).

Ann. LII (1841).

Ann. LIII (1841).

LENZ,* admitting the error of his assumption, investigated the subject again in a different way. Assuming the existence of both polarisation and transition resistance in various electrolytic combinations, he showed by experiment that the latter, if it existed at all, must be opposite in its properties to all other kinds of resistance. He therefore regarded its existence as unlikely and joined with OHM† and VORSSELMAN DE HEER‡ in holding that since a transition resistance need not be assumed to account for any known phenomena, (all phenomena which may have such a resistance as their cause being capable of being regarded as consequences of polarisation), it may be ignored.

There is one case, however, in which this transition resistance is dissociated from polarisation, so that its effects cannot be confounded with the effects of polarisation. That is the case in which a current is sent through weak neutral solutions of zinc sulphate between electrodes of amalgamated zinc.§ The electrodes of such an electrolytic cell are not appreciably polarisable. If, then, there is any reduction of the intensity of the current produced by the surfaces of the electrodes, it must be due to transition resistance, not to polarisation. For the change in the resistance of the cell produced by change of its constitution, due to electrolysis, can be made so small by using currents of sufficiently short duration as not to affect the result. BEETZ‖ has already made use of this combination for the detection of transition resistance. His method was that which POGGENDORF used for metals. In two circuits of the same aggregate resistance he passed the current across two and across several surfaces of contact respectively, and found the measured resistance to be the same.

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*Pogg. Ann. LIX (1843).

†Schweig. Journ. LXIII, LXIV. See also Fechner's reply Ibid. LXVII.

‡Bull. Sc. phys. nat. Neerland, 1839 (Liv. V), 1840 (Liv. II).

§Du Bois Reymond, Monatsber. Berl. Akad., 1859; Patry, Pogg. Ann. CXXXVI (1869).

‖Pogg. Ann. CXVII (1862).

As I have already pointed out,* however, it is not clear that in the two circuits he used, the number of the times of the current's passing across surfaces of contact was different; and, therefore, the equality of their resistance cannot be held to be decisive of the absence of transition resistance.

I had occasion some time ago, in connection with some experiments on the resistance of solutions of zinc sulphate, to determine whether there was sufficient transition resistance to interfere with the accuracy of my results. Although the measurements, which I made for my own satisfaction, apply only to one special case, it may be worth while to put them on record.

The method which I used was essentially the same as that of BEETZ, but I took precautions which excluded doubt as to the number of times the current had to pass from electrode to electrolyte, and from electrolyte to electrode. I chose as electrolytic cell one devised by Prof. TAIT, for the absolute measurement of the conductivity of saline solutions. It consisted of a box about 20 cm. long, 10 cm. wide and 10 cm. deep, made of pieces of plate glass cemented together with marine glue. It was divided into two nearly equal compartments by a plate of glass cemented to its bottom and sides. The two compartments were joined by a tube which passed through this plate. On both sides of the box, near both ends, narrow strips of glass were cemented to form grooves for holding the electrodes; and the latter were so accurately fitted that their position in the box could not vary. Thus the column of liquid between the electrodes had a perfectly constant length. Two similar sets of strips of glass were cemented on each side of each compartment near those intended for the electrodes. These were intended to hold thin plates of zinc. Thus four such plates could be inserted parallel to the electrodes. The current through the cell passed both across these plates and around them; but the plates were fitted so accurately that the fraction of the current which passed around them must have been indefinitely small. The section of the compartments was so large relatively to that of the connecting tube, and the plates h I used were so thin (about 0.8 mm.) that, though their

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R. S. Edin., 1874-5. p. 555.

insertion across the cell increased slightly the depth of the liquid and displaced a certain quantity of liquid by a better conductor, the change produced in the resistance of the cell must have been very small. The specific resistance of the solutions I used was about 28 ohms, and the ends of the tube connecting the compartments were about 6 cm. from the electrodes. The total resistance of the cell was about 3000 ohms. With these data it may be easily shown that the change in the resistance of the cell produced by the insertion of the plates could not be more than between $\frac{1}{15000}$ and $\frac{1}{20000}$ of the resistance of the cell itself. The fact that the connecting tube was completely surrounded by the electrolyte and the large volume of the box rendered it easy to prevent any variation of the resistance of the cell due to change of temperature during the short time necessary to make a measurement. The electrodes and the four plates described above, were of zinc, carefully amalgamated. The resistance of the cell was determined by using WHEATSTONE'S bridge, in the same way as when the resistance of a metallic conductor is measured. In the galvanometer branch of the bridge, I used one of Sir WM. THOMSON'S very sensitive galvanometers, whose resistance was so proportioned to the resistances in circuit as to give it the greatest possible sensitiveness. The solutions which I used were of zinc sulphate, bought as pure and refined by crystallization. Their density was about that of minimum specific resistance. In order to prevent the condensation of dissolved gases on the surface of the electrodes and plates, the solutions were boiled before each set of experiments, and the electrodes and plates were kept for some time in a boiling solution of approximately the same density as that in the cell, before being used. I found great difficulty in getting the electrodes and plates into such a state that they would neither originate a current themselves when dipped in the solution, nor become polarized when a current was sent through the circuit. In some cases, however, I succeeded, and was therefore able to make the necessary measurements. In these cases the observations were, of course, very simple. They consisted in the measurement of the resistance of the electrolytic cell, first without the plates, then with the plates, and again without the plates, each measurement being preceded and succeeded by tests of the electrical similarity of electrodes and plates. Without the plates the current had to pass across two surfaces of contact between amalgamated zinc and electrolyte. With the plates it had to cross ten such surfaces. If there had been any transition resistance, therefore, the measured resistances in these two cases should have been different. In no case, however, was I able to detect any difference greater than could be accounted for by the mere insertion of the plates. In some experiments in which I used a connecting tube so small that the resistance of the cell was about 4,000 ohms, I could detect no difference at all. In others in which I used a tube of larger bore, so that the resistance was about 1700 ohms, differences were noticeable, but they were not such as to necessitate the assumption of a transition resistance to account for them.

The apparatus which I used enabled me to measure resistances accurately to ·1 ohm. It is therefore clear that the transition resistance which the current meets in passing eight times across the bounding surface between amalgamated zinc electrodes, of the area mentioned above, and solution of zinc sulphate, does not amount to one-tenth of an ohm, and that therefore the transition resistance at one such surface is not so much as .0125 ohm.

This result was sufficient for the purpose for which I made the experiments.

The above experiments were made in the Physical Laboratory of the University of Edinburgh. I am indebted to Prof. TAIT for his kindness in furnishing me with the necessary apparatus.

ART. VII. NOVA SCOTIAN GEOLOGY—HALIFAX AND COLCHESTER COUNTIES. BY PROF. D. HONEYMAN, D.C.L., &c.

Read 14th May, 1883.

BY looking at the Map of Nova Scotia it will be observed that the Counties of Halifax and Colchester are large. Halifax [illegible] extends from Lat. 62 deg. 13 min. to 64 deg. 5 min. The eastern side of Colchester is in 62 deg. 47 min. The southern line of Halifax County is the Atlantic Coast. It is bounded on the north by the counties of Hants, Colchester and Guysboro'. A large part of the County of Colchester, which includes part of the Cobequid Mountains, is separated from the County of Halifax by the County of Hants. In this Paper, Parts I., II. and III., I intend to confine attention chiefly to the parts of Halifax and Colchester included between the meridians 62 deg. 55 min. and 63 deg. 41 min.

To the Geology of this region I have devoted considerable attention during the past 20 years. The results of my first work were communicated to the Geological Society of London during the time of the London Exhibition of 1862, by request of the Nova Scotia Commission. Quarterly Journal of G. S., 1862. Paper "On the Nova Scotia Gold Fields." The results of an examination of the Gays River Gold Field, were communicated to the Institute in 1866, *Transactions.* When I read my Paper "On the Geology of Nictaux, Annapolis Co.," to the Institute on Nov. 12, 1877, my new views on the Geology of Nictaux suggested and was followed by the reading of a paper "On the Geology of Halifax County." The latter Paper was not printed, as I considered it proper to defer the publication of views advanced on the age and foreign relations of certain formations, until I had further investigated the character and relations of the Nictaux formations. Since then I have investigated these formations thoroughly and communicated the results to the Institute in a series of Papers. I have also investigated thoroughly the Geology of the region now about to be examined. I have already, in three Papers, traversed the same field, *vide* Papers on the "Superficial Geology of Halifax and Colchester Counties." Localities and names to which I may now refer may be presumed to be familiar.

SECTIONS.

I would define the general geology in three transverse sections following certain meridians of longitude, so that each can easily be located on any map of Nova Scotia. The map on which I have already defined my work is Mackinlay's Map, Geologically coloured, which I exhibited at the Centennial Exhibition, Phila., 1876, and the Nova Scotia Government departments of the Dominion Exhibitions, in Halifax 1881, and Kingston 1882.

SECTION A, LONG. 63 deg. 35 min.

From Cape Sambro the Archæo-Cambro Silurian (lower) extends 34 miles, 1½ miles of Lower Carboniferous succeeds when we reach the Schubenacadie River. North of this is Hants County.

SECTION B, LONG. 63 deg. 20 min.

From Three Fathom Harbour the Archæo-Cambro Silurian (lower) extends to Gay's River Road, a distance of 28 miles, the Lower Carboniferous succeeds and extends a distance of 20 miles to the vicinity of Truro, then comes the Triassic. Beyond are the Carboniferous, Silurian and Archæan of the Cobequid Mountains which do not come within the scope of our Paper, as the Pictou Railway line is our boundary in this direction.

SECTION C, LONG. 62 deg. 55 min.

From Clam Bay the Archæo-Cambro-Silurian (lower) extends 47 miles to Cox's Brook, a tributary of the Stewiacke River. Succeeding this are 12 miles of the Lower Carboniferous, before we reach the Pictou Railway.

The composite term Archæo-Cambro-Silurian (lower) of the above sections, was first used in my paper "On the Geology of Digby and Yarmouth Counties." *Trans.* It was there explained that *Archæo-Cambro* refers to *Formation*, and Silurian-lower to *subsequent metamorphism* with the introduction of gold and associate accidental minerals. The term "grossly cotemporaneous" has been used to characterize this. It seems to me that this is too indefinite and unscientific. My use of the term "Archæan" is that of DANA in his Text Book of Geology, where it is equivalent to the old term Azoic, and includes the Laurentian and Huronian formations. The Huronian seems to include the Lower Cambrian of certain English Geologists, SALTER and others. H. M. Geologocial Society does not recognize this sub-division of the Cambrian. I explained, *Loc. cit.*, that I used the term Cambrian as it is used by H. M. Survey. In my Paper I was led by *fossiliferous* evidence and sequence to regard the auriferous rocks of Yarmouth as of Pre-Silurian age, Cambrian in Formation, and to give them a lease of a portion of subsequent time for alteration, metamorphism and the acquisition of Gold and Gems, &c. The ssociated granites were prefixed to these and made participants of the same metamorphosing influence, hence the whole complex system was named Archæo-Cambro-Silurian (lower). In my paper, on the Geology of Nictaux, I showed that Geologists had heretofore been mistaken in regarding certain strata as of Devonian age on supposed palæontological evidence. Those views as I have subsequently shown, were confirmed by the palæontological evidence of the Digby cognate formation, which had rightly been regarded as equivalent to that of Nictaux. I also showed that the Middle and Lower Silurian, fossiliferous-strata of Nictaux had not been affected by the *underlying* granite. I showed that the gneisses, which *seemed* to have been affected by the granite, belonged to an entirely different series of rocks, in short, that the granite and associated metamorphic gneissoid rocks were Archæo-Cambro-Silurian (lower) and a continuation of the Yarmouth Series.

In my paper "On Metalliferous Sands," read last session, I showed the correspondence of auriferous rocks in Wyoming, in lithology and minerals, with our own auriferous and the virtual coincidence of age. The only difference is that the Wyoming rocks are regarded as *Huronian*, and therefore Archæan. As our Cambrian is on the border of Azoic, with only doubtful life, there seems to be no formidable obstacle in the way of regarding our gold fields as closely Archæan. However, in the meantime we may characterize our gold fields as Archæo-Cambro-Silurian (lower.)

While I consider that we have little (if any) interval or break between the auriferous and succeeding formations, in Annapolis, Digby and Kings Counties, the case is much different in Halifax and Colchester. This will be seen by referring to sections "A," "B" and "C." It will be there observed that the Archæo-Cambro-Silurian (lower) is succeeded by the Lower Carboniferous. If one were thus to infer the age of the former from that of the latter, it would be concluded to be of Devonian age. This irregular sequence, and the want of distinct fossiliferous evidence, has always been a difficulty in the way of the satisfactory correlation of the formation of our gold fields. In my paper read before the Geological Society of 1862, I illustrated the geology of the gold fields by an examination of the railway sections, especially from the Windsor Junction to Windsor, in connection with the Waverley gold fields and its barrel quartz. (*Vide* paper [with illustration] in "Quarterly Journal," 1862.) I reasoned thus: The rocks are widely different from any member of the Arisaig series, at Arisaig, or elsewhere, in the eastern part of the Province, which ranges from the Devonian to the Middle Silurian. They are extremely metamorphic, more so than any of the preceding. Gold has now been found in them in sufficient quantities to be of economic importance. These considerations seem to warrant the conclusion that the formation in question is Lower Silurian. The author of "Acadian Geology" had, on other considerations, come to the same conclusions. In the discussion that followed the reading of my paper, two eminent geologists, only, took a part. The one considered the rocks of our gold fields to be of Devonian age, the other agreed with me in the views that I had taken. In a subsequent conversation which I had with the former, the granites were referred to, which had been noticed as occurring at Mount Uniacke, but had not been taken into account in the discussion. It was *then* agreed that they were of igneous origin, and might be of Devonian or any age.

Among all the interesting exhibits of gold at the London Exhibition of 1862, there was one which was to me peculiarly interesting. This collection stood at the entrance to the Eastern Annex, in which was the wondrous economic mineral display of Great Britain. The exhibit was from the Dolgelly gold field in North Wales. Here were a magnificent bar of gold, rock specimens and gold in its matrix. Accompanying this was a map by Mr. T. A. READWIN. A pamphlet was distributed, entitled, "Notes explanatory of a map of the faults of the Dolgelly Gold District, undertaken for Mr. T. A. READWIN, by J. W. SALTER, F. G. S., &c." I was fortunate to secure a copy of this pamphlet, which I have carefully preserved as a memento of pleasant intercourse had with its illustrious author, and pleasant walks among the various departments of the exhibition, where any thing relating to "Silurian" was to be found. I looked upon this gold collection as intimately related to that of the gold fields from Nova Scotia, although there seemed to be a difference in age,—the Dolgelly gold being of Cambrian age, while the other was considered to be of Lower Silurian age. The researches and discoveries in the palæozoic geology of old Acadia—New Brunswick, Nova Scotia and Cape Breton—during the past 20 years, have added Primordial or Upper Cambrian, Upper Lingula, Flags, Hudson and Trenton, with their characteristic forms of life. Every effort has been made, especially by diligent study, of the rocks Saint John and Halifax, to correlate our gold fields with the most ancient of the Palæozoic series. The old Igneous rocks have, to a great extent, been resolved into Archæan Metamorphic rocks—Laurentian and Huronian—so that the Lower Cambrian, or Dolgelly, auriferous period seems now to be the only resting place for our own auriferous series of rocks. The want of life, or its existence in low and doubtful forms, seems to indicate this. This view accords with the conclusion at which I had arrived by the lithology, sequence and palæontology observed in the Western Counties, especially of Digby and Yarmouth.

CORRELATION.

Previous investigations in Kings and Annapolis Counties, and especially at Nictaux in the latter, had *re*-conducted to Dolgelly and led to a correlation with the *auriferous* formation of Halifax County. In my unpublished paper, read at the same meeting, on the 12th of November 1877, that I read my published paper, "On the Geology of Nictaux," I made use of Salter's notes on Readwin's Map and compared the Halifax Quartzites and Argillites with the "Lower Cambrian," "Barmouth and Harlech Rocks of Prof. Sedgwick." "The Dolgelly Gold district comprehends the upper part of the Lower Cambrian or Barmouth Rocks, and the lower part of the Upper Cambrian or Lingula Flags (Primordial), which range all along the Barmouth estuary and thence northwards to Festiniog." The whole series of these rocks (Barmouth) consists of a very hard sandstone with beds of purple slate, which occur chiefly in the middle and lower portions of the series, but the upper sandstone beds are frequently interstratified with bands of green slate which distinguish it readily from the overlying formation, viz:—The Lingula Flags or Upper Cambrian. This is a triple formation measuring about 6000 or 7000 feet in thickness, according to Professor Ramsay. It has been divided by my own research, into a *lower* group of black slate and trappean shale, a *middle* group of sandstone, and a thin upper group of very black shale, which in North Wales is rich in fossils."

"Of these formations we have only to deal with the lower, for in that only, at present, are the gold veins worked in the district, but the gold is not confined to these lower members, for the productive mine at Castell Carn Dochan is in much higher rocks. Indeed it is at the junction of this formation with the underlying Cambrian grits (quartzites) that the principal bearing lodes are found." Pp. 1, 2.

SALTER's description of the Barmouth rocks might with very little change be employed in describing our quartzites (grits) and argillites the only difference existing between the English series and our own seems to be accidental. *Their* metamorphism may have taken place in Upper Cambrian time, which seems to correspond with our Lower Silurian which is meant to include the Primordial of Saint John, N. B., the Lower Lingula Flags and the Mira ridge, C. B., *Olenus* and *Agnostus*, Upper Lingula Flags of SALTER's Appendix to RAMSAY's Geology formation of North Wales.

ARCHÆO-SILURIAN (LOWER).

This is a term which I use to denote the granites of the series. At Nictaux these were considered to be igneous rocks of Devonian age and were considered as having so metamorphosed the supposed Devonian fossiliferous rocks, as to have converted them into gneissoid rocks. The inclusion of portions of these gneissoid rocks was also regarded as conclusive evidence of the igneous origin of the granite. The old view is that the granite is of igneous origin and that it is an intrusive rock, the new and orthodox view is that granites are generally metamorphic rocks, and not necessarily intrusive rocks, and that remetamorphism may account for the apparent fusion and intrusion. At Nictaux I found, *first* that the supposed Devonian rocks having fossils are of Middle Silurian age, *second* that the rocks by which they are intruded and metamorphosed are igneous diorites; *third* that in positions where granite and the fossiliferous rocks were in actual contact, the latter were very little metamorphosed and certainly not converted into gneissoid rocks. The granit appeared to be an underlying rock. It had evidently been granite when the other rock was formed upon it. It is therefore at least of pre-Middle or Lower Silurian age.

The gneissoid rocks are identical with those on the west side of the N. W. Arm, Halifax, the granites are identical, except that the variety is greater at Nictaux, the inclusions are similar to those which are of frequent enough occurrence in the vicinity of the line of junction of the granites and gneissoid rocks. There is, therefore, no reason why we should regard the granites of Halifax and county as of different origin and age from those o Nictaux.

ARCHÆAN.

In our field there are three granitic areas correspondin with the three sections. The area of section 1 extends fro Halifax Harbour, westwards to St. Margaret's Bay, a distance o 20 miles, and from the Atlantic coast northward to Hammond' Plains, a distance of 18 miles.

The area of section 2 on the E. side of Fletcher's Lake beyon the Windsor Junction, I. C. R., its extent has not yet been ascertained.

The area of section 3 extends from Lake Major to Ship Harbour, and beyond, a distance of 27 miles. Where I have examined it between Meagher's Grant and Musquodoboit Harbour it commences about one mile north of the main road, Musquodoboit Harbour, and extends 6 miles.

It is thus evident that this formation occupies a very large portion of our field and is entitled to greater consideration than is generally conceded to it.

The part of this formation that is most accessible is the area of 1st section, this is admirably exposed on the west side of Halifax Harbour, the N. W. Arm, and the road at water works and there is little difficulty in traversing it in any direction. I have conducted the Institute over the most exposed portion from Purcell's Cove to York Redoubt Point. This has also been an interesting field study to my students in geology during the past 10 years, so that by this time I am pretty familiar with its details and can dispense with my field-book generally in giving an account of it.

The granites of the region are generally coarse in structure. It is only on the ground of use and wont that they are entitled to the name. Their constituent minerals are, as usual, orthoclase, muscovite and quartz, the two first minerals generally prevail. They are not quartzose and consequently are not first-class building stones. They polish well however and easily, and are favorites with workers, more so than the granites of Shelburne, which are truly granites—quartzose granites. The orthoclase is white, often very white, the mica is black and grey, the quartz is often hyaline and often smoky. In some places the mica of the granite is black, in others it is grey, sometimes both occur. The rocks are largely porphyritic with large crystals of orthoclase, especially the very white variety. Some years ago I found in one of the cuttings of the water works, granite with deep red orthoclase, this has a green foliated mineral in place of the mica. A Museum polished specimen of this rock is very beautiful. The polishing has removed the green mineral, so that the surface is singularly marked. It was thought that the stone would be adapted for ornamental purposes, its extent was found to be small.

MINERALS.

In some places the minerals of the granite are segregated, one of the constituents being found without the other, mica is thus found and also feldspar. Here the mica may be said to constitute the rock, and there is no difficulty in securing specimens of any size. Around these the mixed rock is so coarsely constituted that it would pass for a gneiss in acknowledged Archaean regions. In one place, near a ridge at Long Lake embankment, nothing but feldspar is seen of clayey colour. In this black tourmaline abounds in large crystals. A specimen which was brought to the Museum is very singular, it is composed of feldspar and quartz and mica, the feldspar and quartz are very marked, long and large tourmaline crystals pervade, passing indiscriminately through the quartz and feldspar, indicating simultaneous crystallization of the three. Another large specimen from the same quarter is sub-conical in form, it is composed of feldspar and mica plates, the latter are arranged so as to give shape to the whole. In some places the quartz is snow-white, in this crystals of jet black tourmaline are often found prevailing in clusters. Specimens of those in the museum collection are very striking. There is a specimen in our Webster Collection, it is probable that it has come from the granite region of Paradise, Annapolis County, where white quartz with groups of black tourmaline is of frequent occurrence. The specimen is a crystal of beautiful smoky quartz (cairngorm) with long crystals of black tourmaline permeating the interior. Crystals of tourmaline are of frequent occurrence in our granite area. Groups are sometimes arranged in stellar forms. Small crystals of colourless quartz are often found in the granite under examination. I have a large crystal of opaque smoky quartz which is said to have come from the Queen's granite quarry, where black tourmaline is also found.

CAMBRO (SILURIAN).

The rocks of this series are, 1, gneissoid (ironstone).
2, micaceous.
3, Argillites, slates.
4, " shales.
5, Quartzites (grits).
6, " banded.
7, " calcareo-

(The line of the granite is generally N. E. and S. W. while the line of strike of the formation that succeeds or *abuts* is generally E. and W.)

While all the members of this series are readily recognisable no line can be drawn as a separating line, they all pass into each other insensibly, gneissoid into micaceous and argillites, argillites into quartzites and quartzites into calcareo-quartzites, e. g., Examining the Queen's quarries on the W. Side of the N. W. Arm, we first find the two formations in contact. Abutting against the granite we have a micaceous-schistose rock with distinct bedding, E. and W. strike and North dip, I generally try to secure a specimen at a junction of this kind so as to illustrate it, I did not succeed here, the granite and the schist always separated. This rock passes into the hard gneissoid (ironstone) of the quarry. On the East side of the Arm, at Point Pleasant, we have the same becoming a coarse ferruginous and argillaceous rock with the same strike and dip. The ledges on the east side of Point Pleasant are a continuation, these are generally argillites. 2. At Pleasant street, not far from the Park, there are beautiful exposures of argillite strata. Coming to the shore on the opposite side we find a great ledge of similar strata. At the side and back of these are argillite shales and massive quartzites with veins of quartz, all the three pass into each other insensibly. In the gold fields argillites are seen when mining where the surface would lead to the expectation of only quartzites. 3. The Calcareo-quartzites are a striking illustration. I first observed these on the shore between Cow Bay and Cole Harbour. When walking along the shore, I was surprised to find certain rocks singularly worn, as I have seen Lower Carboniferous Limestone worn on the sea shore, by the action of the waves, while other parts of the same rock had the usual appearance of the hard quartzites exposed to similar action. I found in subsequent chemical examinations that 18 per cent of the highly worn parts of the rock was calcareous, while the other parts were quartzite. The acid only can indicate the passage with precision, which is gradual, the sea indicates it approximately. Similar rock and indications are observed on the Eastern Passage, opposite Lawlor's Island. The constitution of the original sediment and accident are doubtless the causes of the variation. The series therefore, is not divisible into subordinate members or groups.

SYNCLINAL.

On the East side of Pleasant Park, at Steele's Pond is a point where there was in olden times a Three Gun Battery. The rocks of this are exposed on the shore, and exhibit interesting structure. They are seen to dip on the right to the South and on the left to the North. In the centre the strata are bent so as to display a series of parabolic curves. A photograph of this taken by the photographer of H.M.S. Challenger for Sir C. Wyville Thomson, is a very striking picture.

SECTION.

On the right or north of the Syncline the argillite strata become confused, they then become shaly. In the shales I found forms which at first sight seemed to be graptolite stipes but turned out to be chiastolites. In this band all is confusion, dip being at different angles and strike in all directions. At length the strata become slaty having a distinct southerly dip and cleavage at right angles to the dip. The extension of these westerly outcropping in a field has similar structure. Proceeding in the same direction along Pleasant street, splendid outcrops are seen dipping in the same direction, opposite the last of these we have again a fine outcrop on the shore; here the dip is also southerly and the strike nearly East and West. This outcrop was referred to above, as exhibiting slates and shales, passing into quartzites with veins of quartz. These outcrops are an interesting study, not merely on account of the transition just referred to, but also on account of the metamorphic phenomena which are beautifully striking and instructive. The last, street section, shows beautiful wavy lines of bedding with a southerly dip, slaty cleavage at right angles, joints and other striking features, e. g., concretions? around which the wavy lines are seen to curve and then return to their original course. Some years ago I examined similar argillites exposed in blasting the foundation of the Young Men's Christian Association Building in the City, these were seen dipping in the same direction with similar cleavage. A specimen in my rock collection in the museum, shows pyrite in flat rhomboid crystals which might be mistaken for ganoid scales. If the arrangement from this to the syncline were to be regarded generally regular, it would indicate a great thickness of argillite strata. There may be doubt, however, on account of obscuration of the intermediate strata, as well as the probable causes of the existing arrangement of strata, lateral pressure, non-intrusion. Returning to the syncline and proceeding to the left, south, we have first an obscuration of strata, then a point with confusion of strata, again, obscuration and then a ledge with crumpled bedding of argillites and a northerly dip. Here too there is cleavage and joints with glaciation and scooping in the line of joint, showing beautiful lines. The glaciation is S. 38° E. A ledge to the south of this and next to the fort at the *Point*, is composed of quartzite strata with overlying slaty strata, an arrangement similar to that observed at Cranberry Head, Yarmouth. (*Vide* Paper on the "Geology of Digby and Yarmouth Counties." *Trans.* 1881-2).

On the quartzite *stratum* are seen *markings* when the shaly strata are removed, these are considered to be *Helminthites* (worm tracks). I have pointed out these again and again to members of Institute, to students and others for several years. Every season there are new exposures. I have tried to secure specimens for the museum but without success, on account of the great hardness of the *stratum*.

On the west of the syncline, the confused strata on the right, the obscuration and confused strata on the left, is the road succeeded by confusion. Steel's Pond and Miller's Field, with wonderfully crumpled strata on either side; Pine Hill, the seat of the Presbyterian College, beautiful country residences and the Penitentiary. We have now reached the North West Arm. Crossing to the opposite side we come to the Sugar Refinery. Here we find the argillites of the syncline continued. The rocks of which these are a part, are exposed in a beautiful and instructive section which I would now describe. The stratified rocks—argillite and gneissoid—extend a considerable distance to the right, N. W. and left. In the latter direction they extend to the Point, at the entrance to the Arm where we have the Ironstone (gneissoid) Quarries. In the section succeed the granite of the Queen's quarries. The gneissoid rocks have the northerly dip of the Point Pleasant extension and of the previous section. On the road to the Queen's Quarries they are seen butting against the granite as a distinct micaceous schist. At the Junction the two are so loosely coherent that I found it impossible to secure a *specimen* which would indicate the Junction. We now come to Purcell's Cove, where the gneissoid rocks succeed the granite in section and butt against the granite and maintain a northerly dip. The granites again come forward to the section and continue as far as Falkland Village, where they are again succeeded by gneissoid rocks. On the shore the first of the latter is seen to *overlie* the granite. At the Junction they are so firmly coherent that there is no difficulty in securing a Junction specimen. From this point to York Redoubt point, the stratified rocks are seen in the section., while the granite retreats, forming a bay which is occupied by the gneissoid rocks. These have an east and west strike and a northerly dip, up to York Redoubt Point. As the granite retreats on the north side of Falkland Village, the gneissoid rocks dip toward it, *seemingly* into it, not away from it. There is no anticline. On the shore the rocks are very ferruginous. Pyrite is found in them in large crystals. Some of the strata are very andalusitic. The mineral is in slender, pearly prisms. These are often arranged in stellar forms. One stratum is covered with these. In York Redoubt, the strata which is seen to overly the granite which rises on the south side of the fort, have a northerly dip and are very andalusitic. The extension of the shore andalusitic strata in the granite bay, are schists without andalusite. This is their character near the Junction with the granite. In the section south of the Redoubt pier, is another kind of rocks which are hard to characterize; they might be called a quartzite. In these are abundance of *discinoid* forms. I am very doubtful regarding their character. I find them in three other localities to which I will yet refer. The inclination of strata is low and its direction doubtful until it is decidedly westerly, and towards the associate granite. The granite then comes into the section and alternates with the stratified rocks. At the Point the latter make their exit, and then the granites are the only shore rocks. I have reason to suppose that the stratified rocks appear again at Portuguese Cove. At the Point the stratified rocks have a slight easterly inclination. The junction of these with the granite is very interesting. The two are seen dove-tailing, but not blending. A museum specimen shows this in a striking manner. The stratified part is banded with a right angled termination; another piece is pointed. The granite seems to have been inserted by fusion. In the *discinoid* part there are long veins of quartz with mica. I regard these phenomena as having been induced by *re-metamorphism*.

I am here reminded of an observation which I made on the Nepisigit river, on the Bay des Chaleurs, New Brunswick. *Vide* Paper *Trans.*, 1875-6: "A month among the Geological Formations of New Brunswick."

At the "Rough Waters" we have the junction of the granite and the Bonaventure formation (Lower Carboniferous), granite,

granite *debris*, and sandstone or grit. I became aware of the existence of a distinct stratum of debris when I was trying to find the junction of the solid granite with the sandstones, in order to secure a representative specimen. The debris had been previously observed by Sir W. E. Logan's Geology of Canada. It has also been noticed by Mr. Ells, in his recent report, and by him *united* with the Lower Carboniferous, as the lowest bed of the series. I cannot help believing that if metamorphism were induced in this region, of the intensity to which the Halifax rocks have evidently been subjected, phenomena similar to those under examination would be the result.

Returning to the N. W. Arm part of the section, I would again notice the junction of the Queen's Quarry granite and the gneissoid and schist strata. Dr. Warren and I investigated thoroughly the extension of this line of junction, and defined it as exactly as possible on the Admiralty map of the harbour as we proceeded. We were able to do this on account of the scantiness of the vegetation, the contrast between the white granite and the black stratified rocks, and the minute exactness of the contour lines of the map. The east and west penetrations of the strata into the granite were numerous, some of these were too small for indication on the map, but the larger ones were defined, until we reached the vicinity of the Coal-pit lakes, where the rankness of the vegetation obscured the lines of junction. Afterwards I resumed the investigation, when I examined and observed the strata of the syncline in and around Williams' lake. On the road at the top (west) end of this large lake, the stratified rocks and the granites were again observed in junction. The two were very intimately connected, so as to be inseparable, yet there was no blending. The stratified rocks, in considerable width, proceeded onward, crossed the York Redoubt ~~point~~ road, and seemed to terminate abruptly in the bushes on the west side, —low, swampy ground, extending beyond, to Long Lake. I referred to this extension in my paper of last session, when describing the rocks on our way to the Rocking Stone. We encountered it after a tramp over granites, extending from the vicinity of Melville Island. I therefore recognized it as an old acquaintance. Their occurrence between two sets of granites would doubtless be perplexing to any one but myself, who am the only one that has investigated its true relation to the associate granites. These are thus divided into two by their intervention. The second granites in great force cross easterly, and are beautifully exposed on the SANDFORD FLEMING road and property, and also in the N. W. Arm section. In the latter they are seen in junction with the gneissoid (ferruginous) rocks, as well as in the heights which intervene between the road and section. In this locality pieces of gneissoid rocks are also seen imbedded in the granite in like manner as at Nictaux. From this one might be led to infer the existence of the gneissoid rocks prior to that of the granites, as has been done in the case of the Nictaux gneissoids. Here, as at Nictaux, we attribute the phenomena to re-metamorphism of the granite during the metamorphism of the stratified rocks. In the section on the arm we find argillites succeeding the granites and gneissoids. In these I found numerous crystals of chiastolite. These are prismatic, and of considerable size, larger than the Falkland and York Redoubt andalusite crystals. The granites appear on the side of the road, opposite Melville Island, and then retreat into the elevated and woody region to re-appear on the St. Margaret's Bay road, at the Water works. Here, again, they are seen in junction with the gneissoid. They again retreat, and after proceeding onward, advance to Birch Cove, on Bedford Basin, where they are quarried for ornamental purposes. Their mode of occurrence in Hammond's Plains is well described by Mr. HARE. For information regarding their junction with the stratified Cambrian rocks, I would refer to his paper. *Transactions* 1880-1.

END OF PART I.

ART. VIII. NOTICE OF NEW AND RARE PLANTS. By GEORGE LAWSON, PH. D., LL. D. *Professor of Chemistry and Mineralogy, Dalhousie College and University, Halifax. Nova Scotia.*

(Read 12th December, 1882.)

Part I. Plants collected at Blomidon, Bay of Fundy, King's County, Nova Scotia.

A familiar feature in the physical geography of Nova Scotia is the North Mountain, a table-topped ridge that runs for 80 miles in a straight, unbroken line along the south-eastern shore of the Bay of Fundy, from Annapolis Basin on the south-west to Minas Basin on the north-east, and thus shelters the fruitful valleys of the Annapolis and Cornwallis Rivers. One of the most attractive features in the scenery of Nova Scotia is the bold and strikingly picturesque promontory of Blomidon, rising to 400 feet in height, which forms the north-eastern termination of the North Mountain, and now looks down upon the fertile stretches of waving meadow, blossoming orchards, and scattered towns and villages, as it did in the olden time on the less ambitious hamlets and carefully cultivated fields of the French farmers. The physical and geological features of Blomidon,—its red sandstone strata, mostly covered by a debris-slope, and its continuous summit cliff or wall of dark trap—have often been depicted by pen and pencil, and its zeolites and other treasures of mineral species are shown in most of the public museums of America and Europe. It is not so well known that Blomidon is a rich pasture for the botanist.

In July last an excursion to Blomidon was undertaken, chiefly for the purpose of studying its ferns. The party consisted of Colonel COLLINGWOOD, R. A., and his son PERCY; Dr. CATELL, Deputy Surgeon General; Mr. P. JACK, Mr. GEO. THOMSON, and myself. Having reached Canning the night before, we started early in the morning for Blomidon, sailing down with the tide in a yacht to a place called Big Eddy, which affords convenient anchorage.

The day was spent on the cliffs, and we returned in the evening laden with plants. Many of these have been planted in gardens for study. At present I wish merely to refer to a few of the more conspicuous and interesting species, with the view of promoting further search in what is obviously a very rich locality.

On the summit cliffs many unusual plants were collected, chiefly of northern or alpine type, such as *Saxifraga Aizoon* (Jacquin), which was first detected on Blomidon several years ago by Mr. JAMES H. HARRIS of the Halifax Nursery. It was found by our party in great quantity and in full flower, its masses hanging by its twine-like roots from the perpendicular faces of the trap cliffs, or nestling in cracks. A living plant was shown to the meeting, also dried specimens, illustrating its range, one from Prof. CARUEL, of Florence, collected "in Apenninis Etruriae," another from Snaehettan, Norway, (T. ANDERSON, M. D.) and a third from Point Rich, Newfoundland, (J. RICHARDSON). It is not a British species. It was introduced into English gardens in 1731, and has been long grown in collections of Alpine plants; but it has remained for Mr. POWER, Superintendent of the Halifax Public Garden, to bring it into use for decorative purposes. He is propagating it largely as an edging and bedding plant, and it will, no doubt, form an interesting feature in the artistic flower-beds next summer.

Sedum Rhodiola was also found in quantity and partially in flower, the male and female flowers being mostly on distinct plants. The plant was first found as a Nova Scotian species at Cape Split, some years ago, by Messrs. JACK, THOMSON and PAYZANT. The Rev. Mr. J. FRASER CAMPBELL (now in India) brought it from either Labrador or Cape Breton, and specimens are now on the table from Newfoundland and Orkney.

Cerastium arvense, although an introduced European plant in the United States, is a true native on the Blomidon cliffs, reminding one in its mode of growth there, of the *C. alpinum* of European mountains.

Tussilago Farfara affords every indication of being indigenous in this wild locality. It is not known to grow in cultivated grounds nearer than Yarmouth, in the south-western extremity of the Province, and, as an introduced plant is rare in Nova Scotia. Its occurrence at Blomidon, under circumstances which indicate it to be indigenous, is of special interest to botanists. I have appended a few notes on this plant. *Campanula rotundifolia*, the blue bell of Scotland, is also quite indigenous here, although it grows as an introduced plant only near Twelve-mile House, Halifax county.

The bank of debris that slopes from the top cliffs of Blomidon to the shore, is covered in most places with a growth of birch and other common, chiefly hardwood, trees, beneath which, and especially near the top, in shelter of the cliff and huge masses of rock, there are scattered about magnificent clumps of ferns. *Struthiopteris germanica*, the ostrich plume fern, grows in great luxuriance; also *Polystichum angulare* var. *Braunii*, together with the more common Lady fern, *Athyrium filix femina*, and the *Lastrea dilata*, in many puzzling forms, one of which, var., *Blomidonensis*, with remarkably broad deltoid fronds of great size, is strikingly different from all other forms of this species.

Botrychium Virginicum was also found, not plentiful by any means, but some of the specimens were very fine. *Polypodium vulgare* hung in great green mantles over the bare rocks, and in stony places tufts of *Lastrea marginalis* were everywhere to be seen.

Cystopteris fragilis was found in many places on the lower part of the sloping bank where the rock appeared at the shore, but the specimens were larger and finer in the crevices of the upper cliff. The prevailing form was that described as variety *McKayii*, which differs greatly, in its distant, not approximate, pinnæ, and other characters, from all ordinary European forms, but is probably the most common form of the species in America. It is in fact so common here that American botanists not unnaturally look upon it as the normal state. *Woodsia Ilvensis* was also found extending up the face of the cliff. *Polypodium Dryopteris* and other more common ferns need not be specially noticed.

Returning to Canning in the evening, we started next morning, and botanized the gorge through which Dr. HAMILTON'S road winds up to the summit of the North Mountain. Here also there was a magnificent growth of ferns along the banks of the rill, composed principally of *Lastrea marginalis*, *L. dilatata (spinulosa)*, *Polystichum acrostichoides*, *P. Braunii*, *Struthiopteris germanica*, not very plentiful, *Polypodium Phegopteris* and *Dryopteris*, with fine patches of var. *erectum* of the latter, *Athyrium Filix femina*, *Polypodium vulgare*, &c. Here, with var. *McKayii* of *Cystopteris fragilis*, we found a single tuft of a form with broad leafy approximate pinnæ like the ordinary European state of the plant. It was at this place that Mr. JACK found, some years ago, a tuft of *Woodsia obtusa*, a species which, although not so very rare in the United States, was not previously ascertained to be Canadian. It has indeed been regarded as a Canadian fern, but in my Synopsis, published some time ago, it was pointed out that there was then no evidence.

On the following day we visited the "Look Out," a favourite place of resort for visitors, from which there is a magnificent view of the Cornwallis Valley. Here we obtained a supply of *Woodsia Ilvensis* and also a very few specimens of *Asplenium Trichomanes*, which was very scarce, but was subsequently found on a cliff in a gorge to the westward of Canning, by Colonel COLLINGWOOD. Near the same place Master COLLINGWOOD found *Veronica Americana*. It is necessary to mention, in the interest of visitors to the Look Out, that there is, along the base of the cliff and amongst the stony debris, a great profusion of the Poison Ivy (*Rhus Toxicodendron*), which causes, on many persons, by simple contact, a disagreeable and even dangerous eruption on the skin.

It is remarkable that, with exception of a few local species, nearly all the ferns of Nova Scotia are to be found on the North Mountain.

Part II. Plants discovered at Woodstock, New Brunswick, by Peter Jack, Esq.

In September last Mr. JACK visited Woodstock, and there made some very interesting discoveries. His attention was called, in the greenhouse in the garden of Mrs. CHARLES CONNELL, to a fern found by the gardener in the neighbourhood during the fall of 1881, whilst gathering leaf mould from under the snow. Mr. JACK, perceiving that the fern was *Scolopendrium vulgare*, an extremely rare species on the American Continent, for which we have only the one Canadian locality at Owen Sound, visited the place, some six miles distant, where the gardener had obtained it, but no trace of the plant could then be found. The plant in the greenhouse was a seedling, apparently of two or three years growth. The gardener (Mr. SUTTON) subsequently, however, succeeded, by diligent search, in finding two small plants, both of which have been forwarded to Halifax, and are now in Mr. JACK'S greenhouse. They came with the native moss and mould still attached to their roots, and effectually confirm one of the most interesting fern discoveries made for some years. Since then two more plants of larger size have been received by Mr. JACK, and a frond of one of them is now presented to the Institute. Whilst at Woodstock he visited the station for *Adiantum pedatum*, a wood six or seven miles distant, and found it to be abundant. But he found at the same place a much greater rarity, viz., *Aspidium Goldianum*, not previously known to exist in the Maritime Provinces; also:

Viola Canadensis, which had been found for the first time in New Brunswick by Mr. CHALMERS, of the Geological Survey, a few days before, at another place. At Grand Falls Mr. J. found *Woodsia glabella*, which, so far as known, had only been ascertained to exist in one other place previously in New Brunswick, viz: Tunnel, at Restigouche. *Pellœa gracilis* was found in cleft of rock opposite Woodstock.

Part III. Localities for species of Botrychium.

I have to add the names of a few very interesting forms of Botrychium found during the past summer at Truemanville, in the County of Cumberland, by CHAS. H. TRUEMAN, a science student of Dalhousie College. These are *Botrychium lanceolatum*, Angstrom, and two forms of *B. matricariœfolium*, one of them corresponding to the large state figured by Prof. EATON, from Utica, N. Y. S., the other to what he calls the commonest form.

Mr. JOHN BRITTEN, of Petitcodiac, N. B., writes me that he has found *B. matricariæfolium* in New Brunswick.

Mr. JAMES VROOM, of St. Stephen, N. B., writes me that both Mr. BRITTEN and Prof. BAILEY collected B. *simplex* at Petitcodiac in 1881, and that Prof. BAILEY found it in the College Grove at Fredericton about ten years ago. I have not seen the specimens.

Mr. H. H. BELL of Halifax, found *Botrychium Virginicum* on Partridge Island at Five Islands, in Colchester County, in July 1881. The Island is one of the five from which the place gets its name, is small but high, with very steep rocky sides, bare in most places; a path at one point leads to the top, which is thickly wooded. The fern grows on the top; found three or four specimens.

Part IV. Plants grown by Mr. Jack at Bellahill, from seeds collected by Mr. Howard Stokes, in Manitoba.

Mr. HOWARD STOKES, formerly of Halifax, collected seeds of a number of the Prairie flowers in the Pembina Mountain district in the summer of 1880, and sent them to his father, B. Stokes, Esq., formerly Storekeeper of H. M. Dockyard, now in Europe. The seeds were sown at Bellahill by Mr. JACK, who also gave portions to the Superintendent of the Public Garden. They flowered in the summer of 1882, and proved to be the following species:—

1. *Anemone cylindrica*, Gray. The Cylindrical or Long-Fruited Anemone, so named from its achenes being arranged spike-like on a much elongated receptacle. This plant is fully described in my Monograph of the Ranunculaceæ published in a former part of the Transactions of the Institute.

2. *Liatris scariosa*, Wild, a rather showy plant, and very variable in size and appearance. It extends from New England to Wisconsin and other Western States and southward, as well as into the British Territories; the specimens from the extreme

western part of Ontario and others collected by Senator Schultz in several places in the North-West, show its extensive range.

3. *Gaillardia aristata.* The Gaillardias are all southern and western plants, none occurring east of the Mississippi, *G. picta* is a favorite in gardens. This one is quoted by Torrey and Gray from Missouri, Saskatchewan and Oregon. But the form sent by Mr. Stokes is a large robust lanuginose plant that does not agree with any of the forms described in botanical works. Prof. Macoun, to whom I showed specimens, informs me that this is the form the plant takes when grown on the prairie land after it has been ploughed.

4. *Helianthus giganteus* var. This is also a form of a very variable species.

5. *Heliopsis lævis*, Persoon, a rather diminutive but neat broad-leaved perennial sunflower, the only sunflower, in fact, fit for a button hole, if any are. It derives its name from its resemblance to the true sunflower. It grows in Ontario as well as on the Western Prairies.

Physostegia Virginica var. *speciosa.* Gray, False Dragon Head. This is a robust, showy perennial, 4½ feet in height when in flower, with dark green lanceolate strongly serrated leaves and large spikes of variegated purple flowers. This plant is different from the ordinary garden form of *Physostegia Virginica,* being much larger in all its parts, with larger, darker, almost coriaceous leaves, and long spikes of very bright coloured flowers. It is so different that it has been described as a distinct species. It is the *Dracocephalum speciosum* of Sweet's British Flower Garden, t. 93, and *Physostegia imbricata* of Hook. Bot. Mag. t. 3386. It differs from the ordinary cultivated form of the species by its dense spikes of horizontal flowers, the spikes panicled; the flowers are also of a darker and richer colour.

Petasites vulgaris, a large English herb with leaves two feet across, City of St. John, where it was observed in vacant lots in the summer of 1881. It seems to have spread from a garden after the great fire, and is fairly naturalized. Additional particulars respecting this and some other plants will be given in a future paper.

A number of interesting localities for rare Ferns were also noticed, from information furnished by Mr. VROOM, including new stations in New Brunswick for *Adiantum*, *Asplenium thelypteroides*, *Cystopteris bulbifera* *Woodsia Ilvensis*, *Botrychium Virginicum*, and *Woodwardia Virginica*.

ART. IX. ON THE BONE IN THE HEART OF THE MOOSE. By J. SOMERS, M. D.

(Read January 8, 1883).

IN most ruminants, especially the larger kinds, there is a bent bone at the base of the heart, on the septal side of the origin of the *aorta*, and imbedded in the tendinous circle which gives attachment to the muscular fibres of the ventricle. In the giraffe this bone was two-thirds of an inch in length. Two such ossifications of the sclerous tissue have been met with. In oxen and red deer, an ossified and unossified piece of fibrocartilage is more commonly observed. In the horse these bodies at the septal side of the aortic ring, are rarely ossified until extreme age. *(Owen, Comp. Anat. Vol. 3, p. 523.)*

The fibrous structure of the heart consists of the firm rings which surround the auriculo-ventricular and great arterial orifices. All of these fibres are more strongly developed on the left side of the heart. The left auriculo-ventricular ring is firmly blended at the fore-part of its right margin with the fibrous structure surrounding the aortic orifice, and behind the aortic opening, between it and the two auriculo-ventricular openings there is found a fibro-cartilaginous mass, which is connected with the several fibrous rings, and to which the muscular substance is also attached. In some large animals, as in the ox and the elephant, there is a small piece of bone in this situation. *(Sharpey & Quain's Anat. Am. edition, 1849. Vol. 1, pp. 481-2.)*

The above quotations from OWEN, and SHARPEY and QUAIN refer to an anatomical peculiarity in the heart of ruminants and other herbivorous animals, not reported as existing either in man or other mammals. Through the kindness of Mr. Morrow, our President, I had the opportunity afforded me of making a dissection of the heart of a moose, and of examining the bone found in the septum. The heart under examination weighed four pounds twelve ounces, avoirdupois; length from base to apex, 10 inches; circumference at the base, seventeen and one-half inches. Directly at the aortic opening, where the semi-lunar valves are situated, and opposed to the auriculo-ventricular opening on the right side, I found a bony ring, or, more correctly, a section of a circle, measuring one and five-eighths of an inch in length. It was roughened on its surface, widest at its centre where it formed an acute process on one side. From the centre it diminished towards the end on both sides, terminating in points tipped with fibro-cartilage. I have since examined many hearts of oxen, and have invariably found this bone in the same situation as in the moose. In size and shape it differs but little from that of the moose.

The quotations above—particularly from Owen—would point to the presence of this bone as being due to certain pathological changes consequent upon old age in the animals in which it appeared. But a stricter examination will prove that this bone is not a product of decay, due to the deposition of sclerous or a atheromatous matter in the fibro-cartilaginous tissue of the heart. It is a true bone, developed in a situation where its presence serves an important physiological purpose.

A microscopical examination proved it to possess the histological characteristics of bone tissue, there being the lacunæ canaliculi and haversian canals. An atheromatous deposit would, on the contrary, exhibit the deposition of calcareous matter in the fibrous or other tissue without any attempt at organized structure.

The position of the bone renders it an anatomical curiosity. As to its function, I think it serves the purpose of strengthening the aortic opening, maintaining its potency and giving support to the semi-lunar valves. It is a fact in physiology of the heart that the aortic semi-lunar valves will not permit, even under a pressure, sufficient to rupture them, the passage of water from the aorta into the left ventricle, as shown by Mr. J. W. King's essay on the safety valve action of the right ventricle of the human heart. (*Guy's Hosp. Reports, 1837. Vol. 11, p. 104.*)

Following the systole or contraction of the ventricles, the mass of blood which had been in their cavities is now in the aorta and pulmonary-artery; distending them, the distension of the arterial walls is followed by their recoil. This would drive it back again into the ventricles, were it not for the sudden closure or shutting back of the pulmonic and aortic semi-lunar valves. The pressure which these valves have to bear is very considerable, equalling that of 6 or 7 inches of mercury in man, and of course a still greater pressure in large animals. In regard to the action of the left side of the heart, the needs of the circulation demand that there shall be no regurgitation or backward flow of the blood. It must go forward, otherwise there is produced serious injury to the capillaries of the lungs and to the systemic circulation, a fact well known to pathologists, as in cases of insufficiency or obstruction in openings of the heart in man.

In large animals, more especially those that are required to put forth efforts of strength or speed, which rapidly increase the blood pressure in the whole vascular system, the increased power of resisting pressure afforded by the partial bony ring at the aortic orifice must be of great consequence, so far as the specific functions of the semi-lunar valves here situated are concerned. It must be observed, also, that the bony matter but partly surrounds the aortic orifice, thereby while giving it strength and resisting power, not interfering with the necessary elasticity of the part. More than this, the solid tissue here in the cardiac septum affords more or less resistancy to the valves in the right side of the heart, preventing, during rapid or forced muscular action, the crowding of too much blood upon the delicate tissue of the lungs.

In the various examinations of hearts which I have made, I have not found the second bone mentioned by Owen and others.

ART. X.—ON THE WINTER FOOD OF THE PARTRIDGE AND ON PARTRIDGE POISONING. By J. SOMERS, M. D., F. R. M. S., *President.*

THE "Partridge," so-called, *(Bonassa umbellus)* or ruffled grouse, is like its congeners, *Omnivorous,* its food range being what we may term a wide one, embracing, as it does, the products both of the animal and vegetable kingdoms.

In the spring and summer its food consists of insects—*ova larva* or perfected, of molluscs, principally *pulmonata* (snails), and a wee-toad or frog does not come amiss. From the vegetable kingdom various seeds and wholesome berries, in the early autumn the blueberry and huckleberry, *vacciniei,* constitute a staple article of its food; later on the bird subsists principally upon beech mast, and during the months of October and November the crops of partridges secured by sportsmen and others rarely contain any other food. As we advance towards winter the diet of the partridge becomes more and more restricted, and when the season is well established, and heavy falls of snow cover the ground in woods and open, then our partridge is constrained to banquet upon food material that is most within its physiological requirements and nearest to its reach.

At this season the crop of this bird will be found to contain broken catkins of the birch, "*Betula excelsa,*" broken fronds of shield fern, "*Aspidium spinulosum,*" and leaves and berries of sheep laurel, "*Kalmia angustifolia,*" the proportionate quantities being about nine-tenths of birch catkins and one-tenth fern fronds and kalmia leaves, the proportion of the latter, however, always exceeding that of the fern, as you may observe by examining the three partridge crops presented to you; you will notice that the fern fronds are beautifully fresh and green. Having been scratched by the birds from beneath the snow, which preserves them in this condition all through the winter, there is little room for doubt in regard to the reason why the birds seek for and partake of these fern fronds; for though they contain little nutritive matter, they are yet always succulent and tender, and supply them with the only green food which they can procure during our subarctic winter. The kalmia leaves, you will observe, are sear and coriaceous, just as we find them persisting on the plant during autumn and winter.

The birch catkins contain the male flowers of this tree locked up in their winter sleep. They yield, on analysis, both carbonaceous and nitrogenous matter, and supply, though in limited quantity, matters requisite to the nutritive demands of the tissues of our Partridge: but, as they contain, also, a large quantity of insoluble and unassimilable matter, their digestion requires to be slowed, so that the soluble and assimilable matter may be separated and prepared for absorption into the blood. The firm fronds contain a small quantity of starch and mannite, with a percentage of nitrogenized matter; they are probably of most service supplying to the tissues certain inorganic proximate principles which are necessary to their well-being. Salts of soda, potassia and lime abound in ferns. These substances are as much food requisites as those of organic origin.

In birds the nutritive processes and circulation are more rapid than in mammals, their great muscular activity induces rapid tissue change; they, therefore, require a large amount of food. Hence birds are constant feeders. In them, too, the digestive process is quick in action, and a diminution in their food supply is severely felt and soon shows its effects,—they emaciate, lose their activity, and become slow and torpid.

It is well known that birds, considering the size and weight of their brains, are uncommonly intelligent. This applies particularly to the class of birds under consideration, which become proverbially shy and cautious in localities where they are much sought for by sportsmen; in seasons when food is scarce they very often, owing to their diminished activity, become an easy prey to the gun.

In endeavoring to account for the eating of the kalmia leaves by the Partridge, and the innocuousness of this plant to the bird itself, we may premise that it is taken, not for its nutritive value, but because it acts indirectly by preventing tissue change.

It is taken instinctively, no doubt, though not in sufficient quantity to injure it. Kalmia is a narcotic and arterial sedative and contains a large proportion of tannin, it slows the circulation and retards the passage of the food through the alimentary canal. The active narcotic principle in this plant possesses properties similar to those of alcohol, opium, quinia, &c., viz., to lessen tissue change, and thus, in a certain way compensates for a deficiency in the quantity of food.

It may be said that the foregoing ideas are more or less theoretical, but observations into the life history of our Partridge show that in the winter season when there is much snow the food of our bird consists largely of matter, not highly nutritive amongst them and some not usually taken at an earlier part of the season. In the winter they are usually sluggish, and are easily approached by the sportsman. At this time, also, certain portions or the whole of the flesh is often poisonous, producing when eaten symptoms like those that would be caused by the action of a strong arterial sedative, as a subsequent portion of the paper will show.

Hunters' stories are not always credible, yet there is one very common over the Northern portion of our Continent wherever the Partridge abounds, whose universality might answer for its truthfulness. This story refers to the extreme stupidity exhibited by the behaviour of the Partridge at times. It is well known to be shy in early season, but in winter and after heavy snowfalls a covey may be captured when roosting, provided the hunter begins with the birds on the lowest branches.

We could well believe this story if the birds were short of food and under the influence of kalmia, the narcotic action of the plant being well calculated to produce that torpor and want of alertness which is said to characterize the Partridge during the season of snow. This leads up to the second part of my paper, viz., Partridge Poisoning, so-called. I have recently, in my own person, experienced the effects of eating poisoned Partridge, and may mention here that the circumstances and symptoms of my case, which I am about presenting, destroy most effectually the idea that Partridge poisoning is due to idiosyncracy, or to putrifactive changes in the flesh of the bird. These, on the contrary, show that the poisonous property is due to an external cause which, when present, gives always equal results, but when absent there is, as a matter of course, no such results.

The Partridges were four in number,—three were Birch Partridges, *Bonassa*, and one a Spruce Partridge, *Tetrao canadensis*. The crops and gizzards are here before you for examination. The crop of the Spruce Partridge contains leaves of *Abies balsamea* only, the others contain birch catkins, *Betula excelsa*, broken fern fronds, *Aspidium spinulosum*, and leaves of *Kalmia angustifolia*. Nos. 1 and 3 were shot shortly after feeding, as their full crops and empty gizzards testify. No. 3 had the gizzard full, and was, as the specimen shows, in full digestion. This was a fine plump bird, and could be easily selected from the others after they had been all cooked. I beg to direct your particular attention to the gizzard of this bird, the contents of which, at this time (five weeks from when it was opened), develop freely that odour and taste which we call the Partridge flavour. I supposed if there was ever a poisonous Partridge, this must be the one. My surmise proved correct, as the sequel will show. At dinner I partook of this bird, using the black meat and strongly flavored parts, the other members of my family, of which three were children respectively two, five and ten years of age, partook of the white meat of this and of the second birch partridge, none of them experiencing any unpleasant sensations therefrom.

In my own case no results followed partaking of the partridge until about an hour afterwards. I had, in the meantime, gone out, had attended to some business matters, but while doing so became aware that the poison was about to take effect. My first feeling was one of fullness in the brain. A well marked sense of numbness around the mouth and lips and in the fauces. I thereupon returned home, attempted to smoke some tobacco from a pipe but this occasioned nausea, and I was forced to desist. While standing up to set the pipe aside, I was seized with dizziness and inability to maintain the erect position, and would have fallen on the floor of the room had I not supported myself by resting upon a table near at hand, then, by making a strong effort I was able to cross the room to a lounge. On taking the recumbent position, the feeling of dizziness subsided, but the nausea increased until it terminated in copious and prolonged emesis which continued with short intermissions for upwards of an hour. No pain accompanied the emesis which terminated when the stomach was emptied. Accompanying the vomiting there was pain in the back at the root of the neck and between the shoulders, *i. e.* at lower cervical and upper dorsal vertebræ. This was a peculiar kind of pain of a dull aching character, very much like that which follows over-exertion of the muscles. This feeling passed down both arms, but changed from that of pain to one of numbness and tingling most marked along the track of the ulnar nerves, and terminating in the fingers; there existed also a feeling of coldness well marked in both extremities, and felt—though not in the same degree over the whole body—the sensation as if a current of cold air was directed upon the naked surface; the skin was colorless, the face had a ghastly look, perspiration not increased but rather diminished, urine not increased in quantity, no action of the bowels, pupils normal and the intellect not disturbed.

The most marked action of the poison was upon the circulatory system, as the following observations will prove, the action of the heart being slowed, as evidenced by the fall of the pulse.

I should here explain that I am forty years of age, my height five feet nine inches, weight about one hundred and seventy-two pounds avoirdupois, in good health, regular habits, well nourished, normal, pulse about seventy-six beats, respiration to correspond. The first examination of the pulse was made after the first emesis, the time being fifteen minutes past three, p. m., the count gave forty-six beats to the minute. At fifteen minutes to four, p.m.—that is half an hour after the first examination—it had fallen to forty-three beats per minute, the respiration being correspondingly diminished in number. The pulse remained at this figure (43) for about two hours. The emesis continued at longer intervals, being finally overcome by taking small doses of brandy. After six, p.m. no matter was ejected from the stomach. The pulse then began to rise, increasing also in volume, being forty-five at six, p. m. Increasing gradually from that time until seven, p. m., when it counted fifty-eight. The temperature of the surface began to increase with the pulse, and feeling now comparatively recovered from the effects of the poison. I got up and made an attempt to go to the supper table, but was immediately seized with giddiness, and fell on the floor in a state of insensibility, which lasted for a few seconds only, for as soon as I gained the recumbent position the condition passed off almost as speedily as it had occurred, and before assistance could be rendered I was able to help myself to the place I had previously occupied. I then remained in the incumbent position for over an hour, partook of some tea. Was shortly after able to go down stairs to examine and prescribe medicine for a patient who called to consult me, and experienced no unpleasant sensation, except a feeling of languor, some trembling of the muscles, and chillness of the whole body. When I retired to be bed at eleven, p. m., the pulse registered sixty-eight. I slept well. It was not until twenty-four hours afterwards that the pulse resumed its normal beat, and it took three or four days for the system to recover its usual tone.

Partridge poisoning in the human subject has been variously ascribed to idiosyncracy or individual susceptibility to poisonous properties developed by putrefaction or to intaking of food which inoccuous to the bird, yet causes its flesh to assume poisonous properties. Taking my own experience as an example I think we can eliminate the two first causes assigned—the first, idiosyncracy, I can lay no claim to. The Partridge is a game bird for which I entertain a great partiality, and use it frequently when in season. I have eaten the flesh of the bird as freely since as before my poisoning without evil results. In fact up to that time one year ago I had come to believe I was proof against Partridge poisoning, and had some belief in the first theory of causation, knowing that the condition was not of infrequent occurrence in many persons who had eaten this bird. I partook of the black meat and the strong flavored internal parts of my partridge, or the parts that, owing to the presence there of absorbents and the thoracic duct, would contain matters passing from the digestive organs to the blood vessels. The breast of this bird and flesh of other two were eaten by the rest of the household without unpleasant results. I can, however, understand that the whole of this bird would have become poisonous in time. It was killed shortly after feeding, and the poison had not had time to diffuse itself. This will account for the immunity of those who had eaten of the white meat only. The putrefaction theory is out of court also. The bird was quite fresh, as the gizzard and parts before you testifies. More than this, a man in health with good digestion can dispose of flesh in a state of putrefaction with perfect ease. The third then is the only causation to which we can attribute the development of poisonous properties in the flesh of the Partridge at certain times of the year, and I think the facts stated above are sufficient to convince any reasonable person of the correctness of this view, the symptoms exhibited prove the poison to belong to the class of arterial sedatives—said sometimes to be narcotics. The more powerful of the class are not narcotic in the true acceptance of the term. " There was no tendency to sleep in my case." Their action is to depress the circulation by slowing the movements of the heart acting no doubt, through the peneumo-gastric nerves and probably also upon the great splanchnic nerves; there is also arterial contraction and diminished blood in the capillaries, hence the bloodless skin, vomiting, vertigo and loss of consciousness experienced in this case.

An extract from a memoir of Dr. Stabler in Griffith's Medical Botany, p. 429 says, a large dose of a strong decoction of *Kalmia latifolia* caused in half an hour vertigo, dimness of sight, great depression of the heart's action and cold extremities, without, however, producing any disorder of the mental faculties. It is said in the same work, on the authority of Dr. B. S. Barton, the American Indians used the plant for suicidal purposes. The symptoms of Kalmia poisoning given by Stabler coincide so closely with those of Partridge poisoning we are safe in assuming that they are due to one and the same poison. It is also conceded from a therapeutical point of view that Kalmia Angustifolia is more active than *K. Latifolia,* the former plant being the one found in the stomachs of our Partridges during the winter season.

APPENDIX.

A SUPPOSED DEEP-SEA FISH.

OUR fish was found at Cole Harbor Dyke, east of Halifax, early in January, and exhibited in the city on the 16th and for some time after. It had been thrown ashore during a storm. Unfortunately, the fish was not preserved in the form in which it was found. It was roughly skinned and the carcass was thrown away, so that a great part of its scientific interest is gone. Having never seen any fish like it, I was puzzled to characterise and name it. It was taken away and I never expected to see it again. In the meantime its general form, with the tentacles on its head, suggested an affinity with the *Lophius piscatorius*.

A description of it given by the owner, Mr. Main, in the Halifax newspapers, led Prof. Baird to make enquiry after it with a view to purchase it. He suggested that it might be a *Himantolophus*.

On referring to "Gunther's Introduction to the Study of Fishes," I found the description of this deep-sea fish. It seemed to agree in many points with the appearance of the fish, while at the same it differed. It is now a specimen in the collection of the Provincial Museum. I have set it up in better form. In doing so I have at the same time studied its character, and come to the conclusion that it is more nearly allied to *Ceratias* than *Himantolophus*. I quote "Gunther's" definitions of both:

"Twelfth Family—PEDICULATI.

"LOPHIUS—*Lophius piscatorius.*

"CERATIAS: Head and body much compressed and elevated; cleft of the mouth wide, subvertical; eyes very small; teeth in the jaws rasp-like, depressible; palate toothless; skin covered with numerous prickles. The spinous dorsal is reduced to two long isolated spines—the first on the middle of the head, the second on the back. The soft dorsal and anal short; candal very long; ventral, none; pectorals very short; two and a half gills; skeleton soft and fibrous.

"*Ceratias holbolli*"—a deep-sea fish. Only a few examples have been found near the coast of Greenland and from the mid-Atlantic, the latter at a depth of 2,400 fathoms. Deep black.

"HIMANTOLOPHUS.—Head and body compressed and elevated; cleft of the mouth wide, oblique; eyes very small; teeth of the jaws rasp-like, depressible; palate toothless; skin covered with conical tubercles. The spinal dorsal is reduced to a single tentacle on head. The soft dorsal and caudal and pectoral short. Ventrals, none. Three and a half gills. Skeleton soft and fibrous.

"This is another deep-sea form, hitherto found in very few examples in Arctic and mid-Atlantic ocean. The single tentacle is beset with many long filaments at its extremity, thus answering the same purposes which is attained by a greater number of tentacles. Deep black."

I now give the dimensions of our fish, with remarks:

	feet.	in.
The length from snout to caudal fin is..........	3	
The depth of the body is......................		9
The girth is..................................	2	
Head—from snout to gill opening, the length is..		9
The mouth is open. Its vertical measurement...		3½
Its width is..............		2½
The eyes are small. Interorbital space is.......		4

Teeth in the jaws rasp-like, depressible. Skin covered with numerous prickles (conical tubercles), a few pointed, the greater number truncated with perforations in the tops. The sides of the head and its inferior part have only a few. The spinal dorsal is reduced apparently to one long isolated spine on the head. On the back is a space without tubercles, having the skin, so as it might have accommodated another spine of some sort.

The *dorsal fin* has a width of	6 in.
It has four rays—the length of the 3rd and 4th is	4 "
The *anal fin* has a width of	2½"
It has four rays—the largest is................	4 "
The caudal fin is long and broad; the length of the upper ray is	9 "
of the lower............................	8 "

It has eight rays, the four middle ones are *dichotomous*. They are broad and coated with flesh, etc. Skin having prickles and tubercles. It is sometimes hard to convince our fishermen that the tubercles are not *barnacles.* The fin rays have, not unaptly, been compared to coral branches.

The width of the *caudal fin* is from 7 to 8 inches.

There are no *ventral fins.*

The pectorals are very small, being 1½ x 1 inch each.

The number of rays is 18.

They are situate *above* (not after) the gill openings. They thus *seem* to have an anomalous position.

These pectorals are so widely different from those of the *Lophius piscatorius* and seem to exclude our fish from the family *Pediculati.*

What remains of the integument of the fins is black.

There is a spiracle at the back of the tentacle. The gill openings are two in number. If they had opercles these have been destroyed.

Shrinkage may have reduced the orginal dimensions.

The color now is blackish brown. It was much darker when I first saw it.

D. HONEYMAN,

March 25, 1884. *Curator of Provincial Museum.*

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